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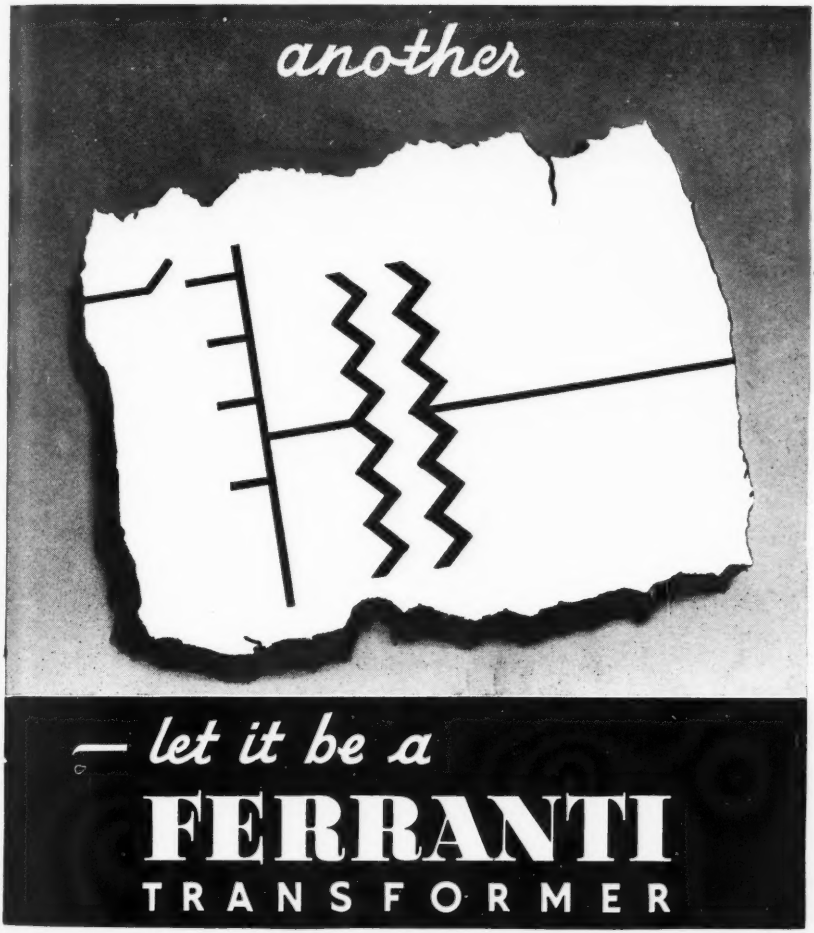
FOUNDED 1872

Vol. CXXX. No. 3366. MAY 29, 1942 6d. WEEKLY



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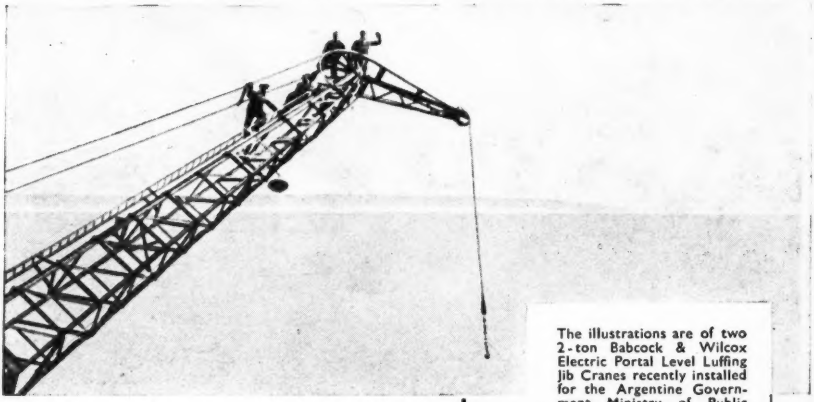
LESS POWER—MORE PROFIT



The illustrations are of two 2-ton Babcock & Wilcox Electric Portal Level Luffing Jib Cranes recently installed for the Argentine Government Ministry of Public Works at the Port of Bahia Blanca, maximum radius 15 metres (49′ 3″), minimum radius 5 metres (16′ 5″), gauge 4.5 metres (14′ 9″).

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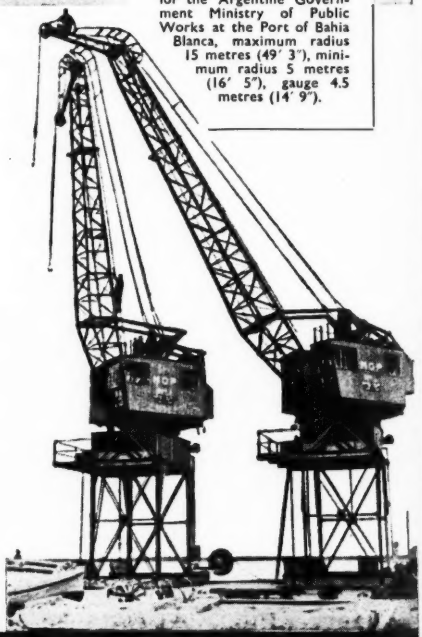

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ELECTRICAL REVIEW

Volume CXXX **No. 3366**

Friday, May 29, 1942

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ELECTRICAL REVIEW

THE OLDEST ELECTRICAL PAPER — ESTABLISHED 1872

Vol. CXXX. No. 3366. MAY 29, 1942 6d. WEEKLY

The Generating Question

Allocation of Production Costs

PUBLIC appreciation of the value of electricity supply undertakings as a national asset has undoubtedly been quickened by the high service they are rendering at this hour. Fitting as this appraisement is, however, it is accompanied by certain risks in that unskilful attempts may be made to sweep away what, to outside opinion, may appear to be obstacles to a fuller and more widespread use of electricity. A realistic outlook on the part of engineers will take this tendency into account and strive to ensure that this untutored zeal, which should be their useful ally, is expressed through sound technical channels. In other words, they must prevent " the baby being thrown out with the bath."

Absorption of Savings

Generation makes the strongest popular appeal, partly because the power station has always stood as a symbol, partly because expenditure on generation shows an easily recognisable return in the shape of lower costs and hence retail prices, whereas financial savings made in transmission and distribution have been largely swallowed up in increasing the availability of supply and in coping with the more exacting conditions caused by the greater amounts of power to be delivered.

The idea of economical generation at waterfalls and the transmission of electricity to more or less remote points for universal use has long held the imagination of the public, which is also beginning to understand that the production of electricity from coal differs from this concept in degree rather than in kind, the dominant consideration being the natural advantages of the site. It would appear that some undertakings are more fortunate than others in the situation of their power stations and that they are able to extract further benefit from their position when, as a result of interconnection with other stations, improved load factor warrants the installation of larger and more efficient plant than local conditions would justify.

The Spur of Competition

The facility with which electric power stations can be run in synchronism as a national unit provides a further argument in the same general vein. Nevertheless, it is important not to weaken the incentives to the bold choice of new technical advances and healthy competition in operating proficiency that have done so much towards bringing about the remarkable improvements of the past few years.

Unfortunately, the fine engineering achievement presented by the British system of generation, in so far as it relates to the important question of allocating costs of production among the various power stations, rests upon the insubstantial fabric of a vision of what might have been if an Act passed more than fifteen years ago had no existence. The suppositions this entails seem more worthy of the fine-spun debates of mediæval schoolmen than of the serious attention of engineers of the twentieth century. Moreover, they provide an opening for outside criticism.

To put the procedure on to common-sense lines, constructive proposals are needed from those having intimate experience of where the shoe pinches. A broad-minded attitude is called for, in this and other respects, since the portents are that there will be little room in the future of generation for the kind of individualism, whether of private or public bodies, with personal or local interests, as its main concern. There should, however, be plenty of scope, if appropriate steps are taken, for a co-ordinated individualism that vies to serve best the needs of more than ten million consumers.

Not Quite Fair

So far this country has welcomed, almost too readily, any criticisms of its productive methods in its anxiety to bring about all possible improvements. But sometimes our critics are either misled or unfair. For example, Mr. Eldridge Haynes, an American journalist, writing in the *Daily Telegraph* last week stated that he had seen only one conveyor during a recent tour of industrial works and not a single electric truck or tractor. Readers of the *Electrical Review* who have seen many articles on a variety of works will certainly wonder what sort of factories Mr. Haynes was taken to. He also says that the only fluorescent lighting he saw was in two small gauge-inspection rooms, but he should not have reasoned from this that we do not use fluorescent lighting, nor is electric welding such a rarity as he implies. We will agree that there is as yet little infra-red drying, but even in the States it is a fairly recent introduction.

The E.A.W.'s Aims

SINCE it was formed some years ago by Miss Caroline Haslett, the Electrical Association for Women has considerably extended its scope. It's primary purpose was to make women "electrically minded" and much of the domestic electrical development during the past few years can be attributed directly to it. The original aim still stands but in addition it now inculcates the doctrine of civic responsibility in the minds of its members—a matter of extreme importance now and undoubtedly of greater moment after the war. The Association canalises the desires of women for better home conditions and inevitably directs them towards the greater and more efficient use of electricity.

Transformer Hum

EARLIER reference has been made in these columns to the research carried out by Dr. J. Swaffield (a Grad.I.E.E., by the way) at University College, London, into the causes of noise emitted by transformers. Particulars are now published as an E.R.A. communication to the I.E.E. *Journal* for May. The main cause is shown to be magneto-striction, or the vibration set up by simultaneous changes in length and area of the core in a magnetic field. Although it may be impracticable at present to obtain a core that is free from vibration, these investigations appear to indicate a starting point for future core design which would eliminate the noise at its source.

Silver Busbars

APPARENTLY serious attention is being paid in the United States to the suggestion that silver taken from idle reserves should be substituted for copper and other metals needed for munitions making. One example mentioned is in the replacement of existing busbars and the construction of new busbars. If the labour-time so spent is justified, there would, of course, be no objection electrically to a changeover, since silver has the highest conductivity of any metal (being more than 7 per cent. better than hard-drawn copper) and can be brazed or soldered without difficulty. The specific gravity of silver, being 20 per cent. greater, might sometimes entail additional bracing.

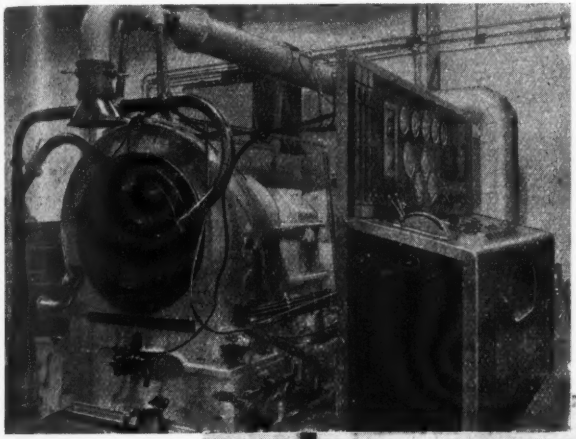
Gas-pressure Cable

HIGH-VOLTAGE cables in which voids in the dielectric that lead to ionisation troubles are ironed out by gas pressure have been in successful operation in this country for several years. In the United States cables for 132 kV or so have been of the oil-filled type (as, in many cases, here also) until the Detroit Edison put into commission recently a seven-mile length of 0.63 sq. in. three-core gas-pressure cable for use at 120 kV. In the design chosen, out of the three or four available, the gas (nitrogen at 200 lb. per sq. in.) is in a welded pipe exterior to the cable. Each type of cable has its advocates and further experience of comparative performance will be all to the good.

Aero-Engine Testing

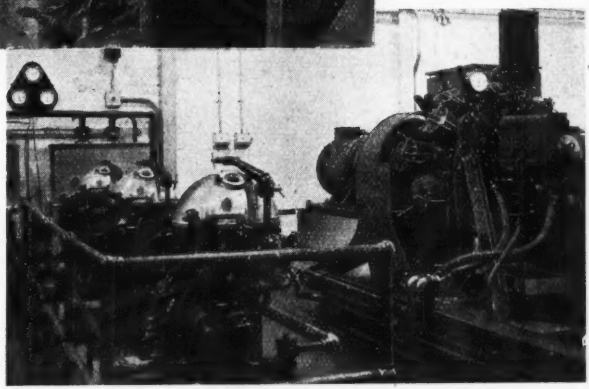
The Electrical Aspect

IN a large aero-engine factory we recently had an opportunity to see and learn something about one of the most interesting groups of electrical applications in the production of "Bristol" aero-engines, namely, to engine testing. On the production line the various engine components are built up gradually on a vertical assembly plate, *i.e.*, axially to the engine shaft, and this assembly plate remains in position after being put in and out of circuit by hand-operated contactors. The resistances, contactors and starting equipment are housed as a complete unit in a sheet-steel cubicle. At first, when the engine is a "tight fit," low speed is required, but as the engine fit is eased the rate is increased by hand control until a settled speed of about 520 RPM is attained, at which speed the engine is motored continuously for a few hours.



In keeping with the severe demands of the blower testing there is an elaborate desk-type control panel; high-speed gear is shown on the left

As the engine runs lubricating oil is passed through it in a circulating system, the circuit including a 60-gal. tank in which the oil is heated to and maintained at 60 to 80 deg. F. by means of eight 1-kW Reyrolle immersion heaters, which are thermostatically controlled to cut in and out as a whole, at the temperature limits mentioned, by an E.A.C. contactor. On its way from the tank to the engine the oil is passed through an Alfa-Laval centrifugal filter which is driven by a small AC motor table mounted at the side of the machine.



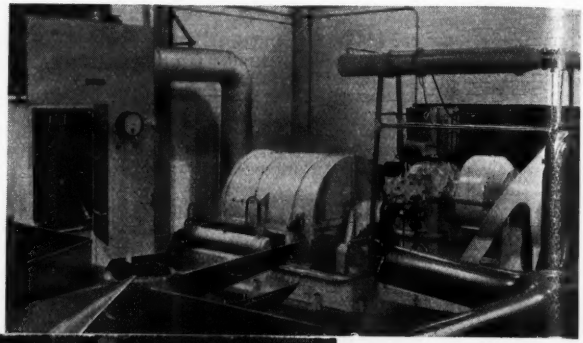
On the running-in test stand the engine is coupled to a 50-HP, DC motor (oil cleaning filters, left, oil heating tanks, rear); a "Bristol" Hercules 1,600-HP engine is shown

the equipment is completed as a means of fixing the engine to the various testing stands.

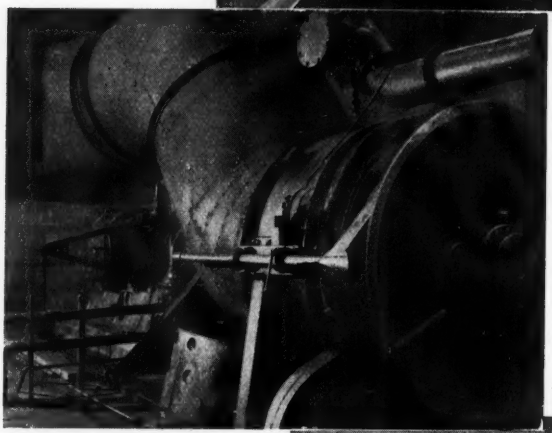
In the running-in test, for instance, the plate is first bolted to the test stand; then the engine shaft is coupled to the shaft of a 50-HP, 900/1,800-RPM English Electric DC motor which drives the engine through a 3-to-1 ratio reduction gear. The variable-speed operation of the motor is effected by Igranic resistance control, the resistances

After running-in, the engine, this time

complete with its propeller, is given a hanger or endurance test, the engine running under its own power. To simulate the actual service conditions as far as possible the engine on this test is started up by a motor of exactly the same type as that used in service in the aircraft. It is a 24-V, DC Rotax unit complete with a 60-to-1 ratio speed reduction gear, and it measures overall only about 18 in. long and 9 in. diameter. The ultimate speed is variable down to about "inching" by means of resistance control. On the test this starting motor is supplied from a small rectifier set in the test control room. In a circulating-oil system for lubricating the engine on test there are both oil-heating and oil-cooling equipments, heating up being necessary during the early stages of the run and cooling later. The oil-heating arrangements are similar to those for the running-in test, except that in this case there are two tanks each fitted with six 1-kW thermostatically-controlled immersers. The oil-cooling equipment is of the circulating type and an incorporated motor fan blows air over the exterior surfaces of the tubes.



The blower (super-charger) is often subjected to exacting testing on a blower test rig



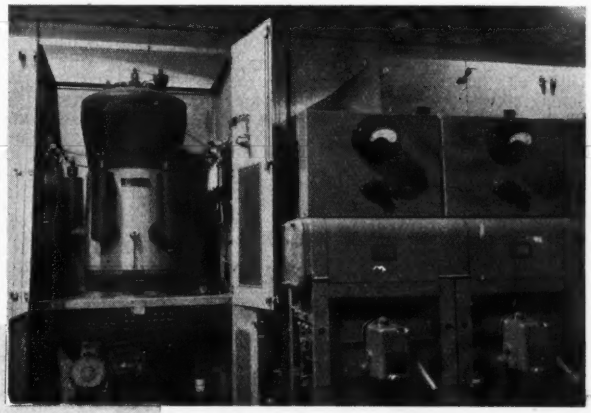
For brake testing the engine is mounted on the end of a large air-duct system; the 150-HP starting motor is seen at the back, under the ducting

The cooling motor and fan for brake testing are isolated in a separate chamber; the motor is seen through the door, wind-tunnel right

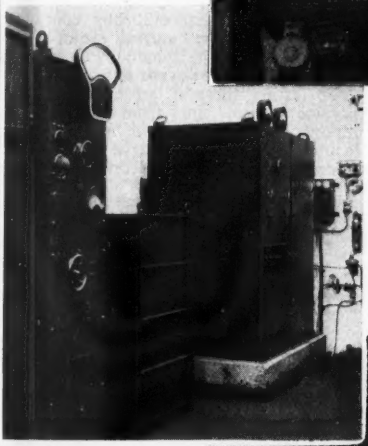
The engine is next subjected to a braking or efficiency-indicating test for which it is mounted on the outlet end of a large air-duct system "wind tunnel." It runs under its own power, of course, but is started up electrically and, as in this case it is loaded, much more starting power is required. So there is a permanently installed

150-HP variable-speed, 1,000/1,700-RPM Brush DC starting motor which is coupled to a shaft driving the engine *via* a hydraulically operated clutch. Load is applied by means of a water brake on the main shaft between the clutch and the engine. This incorporates vanes which operate against water pressure supplied by a 25-HP English Electric induction motor with Electrical Apparatus Co. star-delta control.

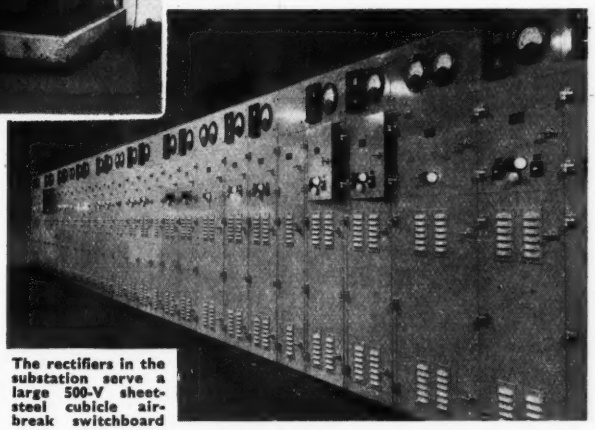
The water is circulated through a system in which it is surface cooled by air blast from a 13-HP motor-driven fan as it cascades in a tank structure. As soon as the engine is running satisfactorily under its own power the clutch is released and in this way a switch incorporated in the clutch-operating lever trips the starting motor and at the same time switches on a warning light on the control panel. For varying the load (water pressure) on the engine there are sluices in the brake system which are operated by a small motor on the brake equipment.



The rectifiers are individually housed in sheet-steel cubicles; end of 400-V AC board on right



The hanger and brake testing plants are controlled from a separate room; starter-motor panel on the left, starter-motor resistance in the centre, cooling-motor panel on the right, remote control panel for sub-station circuit-breaker by door

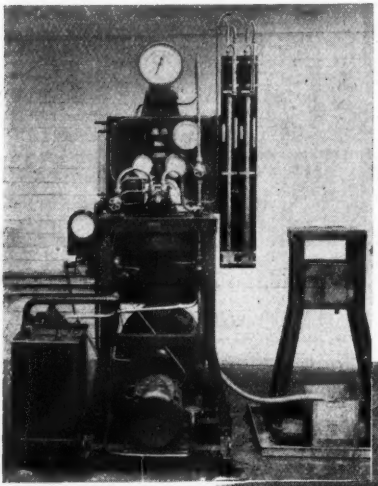


The rectifiers in the substation serve a large 500-V sheet-steel cubicle air-break switchboard

For cooling the engine on test there is a 550-HP, variable-speed, 350/950-RPM, DC motor directly coupled to a fan at one end of the wind-tunnel which blows the air directly on to the engine at the other end of the ducting. The motor speed is varied by Igranic hand-controlled contactor and resistance equipment which, complete with the starting gear, is all mounted in a sheet-steel cubicle in the control room. There is similar control for the starting motor, but

in this case for two speeds only, namely, 250 RPM for running-up and 350 RPM for engine firing.

The cooling fan and its motor are isolated in a separate room at one end of the wind-tunnel, and on the fan inlet side the complete wall of the room is constructed with movable shutters. To prevent starting up the fan motor with the shutters down there is interlocking between the shutters and the motor switch, so that the motor is always on open circuit when the shutters are down (closed).

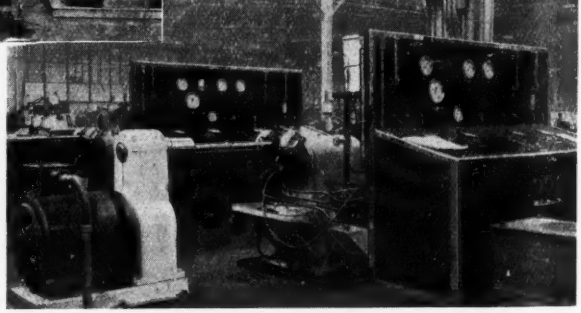


The petrol pump rig test is really a calibrating one designed to keep a check on the capacity of the pump

In the wind-tunnel itself there is a spring-controlled flap which is held open by the wind pressure. Should the pressure fail, however, the release of the flap will open the engine ignition circuit and so prevent running the engine without its cooling medium. The hanger and brake-testing plants, complete with their separate control rooms, are arranged in buildings quite apart from the production plant. The oil heating tanks are in the control room in which there is a motor-driven extracting fan system for removal of the oil fumes.

Quite often, after either or both the hanger and brake tests, the blower (supercharger) of the engine is subjected to a separate and exacting test for speed, bearings and oil leaks on a separate testing equipment known as the blower test rig. Mounted on this equipment the blower is driven at a very high speed by a 500-HP, DC, E.E. motor which is directly coupled to a David Brown speed-increasing gearing to which the blower is bolted and coupled, with an ultimate speed range of 1,800/3,600 RPM. The speed is increased in five stages, by a method and equipment similar to those employed for the tests already referred to, the initial motor speed limits being 900 and 1,800 RPM. The motor is forced-draught cooled by means of a ducting system incorporating a small motor-driven fan which draws dry air from an adjacent room, passing it under the floor and into the motor casing at the bottom, to be discharged through vents in the motor end brackets.

A circulating system by which the blower is served with lubricating oil during the test incorporates a small heating tank equipped with two 1-kW thermostatically controlled immersers and a small vertical motor-driven pump mounted on the dynamometer gearing. In keeping with the severe demands of the blower testing there is an elaborate E.E. desk-type control panel from which all the components are controlled and the test measurements are read. The actual desk portion of the board is the operating panel and is equipped with push buttons for dynamometer circuit-breaker trip and close, dynamometer start and stop, fan motor start and stop, oil pump start and stop, oil heaters on and off, and pilot lamps for all these circuits.



In the rear cover test rig the gearbox takes a certain load of which that applied by the generator (left) is the equivalent

One end of the cabinet of which the operating panel forms the top is practically in line with and very near the blower on test, and mounted on this end are emergency

controls for the dynamometer. In the cabinet itself are housed the contactor equipment for the fan and oil pump motors and the oil heaters. On the front of the cabinet are mounted controls for the DC circuit isolating switch, the dynamometer shunt field rheostat and the AC isolating switch. Surmounting the operating desk at the back is a vertical panel on which are mounted the various speed and oil-pressure gauges required to give the necessary testing information.

Power Distribution

While it is not the purpose of this article to deal primarily with the works distribution system, a brief description of one of the works substations which is specially devoted to supplying the complete engine-testing equipments already referred to is advisable in order to afford a fuller appreciation of the testing installation. A nine-panel truck-type cubicle Crompton Parkinson switchboard in this substation is arranged on the works 11-kV ring-main system. From it are supplied 1,460-kVA rectifier transformers and 500-kVA transformers for AC supplies. All the transformers are separately housed in isolating chambers which open out on to the roadway. Each rectifier transformer is connected 12-phase star on the secondary side, and two G.E.C. steel-clad mercury-arc rectifiers are fed at 600-V six-phase, *i.e.*, one section of the split 12-phase supply.

The rectifiers, which are individually housed in sheet-steel cubicles, serve a large 500-V G.E.C. sheet-steel cubicle switchboard with air-break switches controlling individually or in limited groups the variable-speed testing motors referred to. From the 500-kW transformers 400-V, 3-phase power is fed to a "Klad" type switchboard from which are fed the AC motors of the testing plants.

Most of the main testing motors are supplied direct from the circuit-breakers in the substations, the breakers being remotely controlled from the motor position; for instance, in the brake-testing control room by the door there is a simple on-and-off push-button contactor unit from which the circuit breaker in the substation controlling the starting and cooling motors is operated.

Component Testing

So far we have dealt exclusively with the testing of complete engines after production. In the factory proper, however, there are some component-testing equipments of rather special electrical interest. For instance, in the rear cover rig test electricity is used both as a means of power absorption and for driving the testing equipment. The rear cover is the part of the aero-engine which drives an auxiliary gearbox serving the engine air, hydraulic and vacuum pumps. On test the cover is bolted to a reduction gear on the test stand, which is driven by 50-HP motor. By means of a supplementary shaft from the cover to the gearbox on an extension stand a 20- to 23-kW, 480-V, 2,000 to 2,500-RPM, DC generator is driven, thus absorbing the load which is dissipated in resistances in the control board cabinet. The gearbox thus takes a certain load of which that applied by the generator is the equivalent.

A petrol pump rig testing equipment is served by two motors—a large variable-speed one at the back which drives the pump itself and a small constant-speed one at the front which drives a circulating pump serving the gearbox of the petrol pump with lubricating oil. This test is really a calibrating one designed to keep a check on the capacity of the pump. The two motors are flame-proof because of the presence of petrol vapour from which the control equipment is isolated in an adjacent room, the operating handle projecting through the partition wall.

New Books

P.I.C. Slide Rules. Books of Instructions for the Standard and Reitz Patterns and for the Standard and Reitz and Engineers' Patterns with log-log scale by Miles Walker, F.R.S., with some exercises by Joseph Harrison. Manchester: William Morris Press, Ltd. Price 1s. and 1s. 3d.

These little books describe very clearly the many uses to which the slide rule can be put. Not only do they include the instructions given in the book usually supplied with the rule, but they outline a number of uses, of great value to the engineer, which are not so well known. The books are of general application since both the slide rule in which the log-log scale is mounted on the stock and on the sliding strip are discussed.

The methods of finding cube roots and fractional roots of numbers are explained and, in the book dealing with the electrical and mechanical engineers' slide rule a number of numerical examples are included relating to problems such as the determination of the constants in an exponential equation and the estimation of the value of hyperbolic functions. The use of the slide rule for determining quickly the efficiency of motors or the voltage drop in conductors of known section and length is discussed and some complex mathematical determinations are clearly explained.

These books are of special value to students and their possession will enable the owner to make far greater use of his slide rule than he may have thought possible.—E.W.M.

Short-Wave Radio. By J. H. Reyner. Third edition. Pp. 186; figs. 97. Sir Isaac Pitman & Sons, 39, Parker Street, London, W.C.2. Price 10s. 6d.

In the new edition the opportunity has been taken to amend certain details and to re-arrange and expand other sections, including the chapter on receiver design. The important subject of frequency modulation has been considered in a separate chapter.

Resonance Problems

Examples of Their Practical Bearing

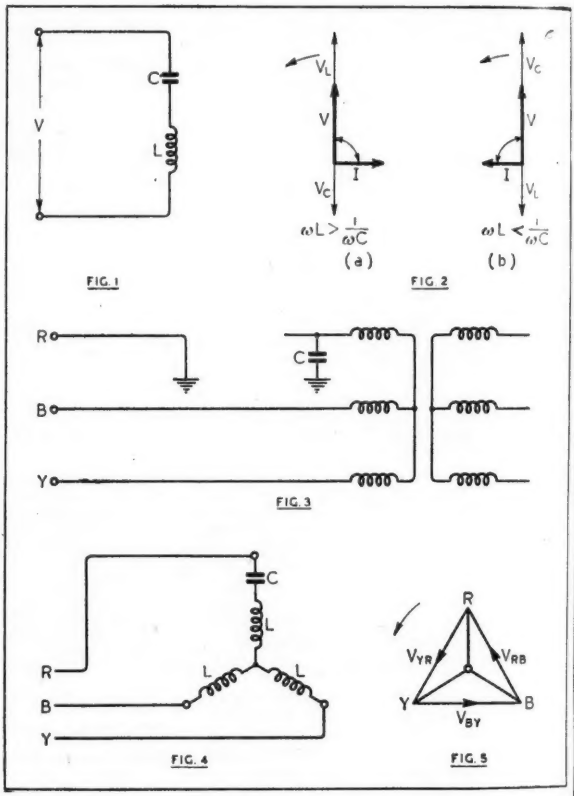
By T. F. Wall, D.Sc., M.I.E.E.

RESONANCE phenomena in high-voltage transmission systems may be evoked by a large number of causes and, in many cases, not only may serious voltage rises result but other disturbances may develop, the reason for which may appear at first sight to have little or no connection with the familiar characteristic facts regarding the behaviour of circuits under resonance conditions. An important practical example of such a disturbance due to conditions in the neighbourhood of resonance will be considered in what follows.

Whilst in the case of high-voltage electricity supply systems, resonance is nearly always a source of danger to be carefully avoided, in the case of radio and also many light-current circuits, a condition of resonance is a fundamental requirement and an example of the effect of a small departure from resonance in a radio transmission circuit will also be considered in this article.

In fig. 1 is shown a simple series circuit comprising a condenser of capacitance C farad and an inductance of L henry. In figs. 2*a* and 2*b* are shown the vector diagrams for this series circuit, when the supply frequency is a little above the natural frequency of the circuit, that is, when $\omega L > \frac{1}{\omega C}$ and when the supply frequency is a little below the natural frequency, that is, when $\omega L < \frac{1}{\omega C}$. The respective current vectors are in direct opposition of phase. The effect of the current leading on the supply voltage, illustrated by fig. 2*b*, may produce important disturbances in the operation of the system.

In fig. 3 is shown diagrammatically an overhead transmission line system of which one line has broken so that an end makes contact with the ground. The corresponding equivalent circuit, in regard to the present problem, is shown in fig. 4 and it is necessary for the investigation that the current vector diagram for the star-connected circuit of fig. 3 should be obtained. The star-voltage and the line-voltage vector diagrams are shown in fig. 5 and, by the use of complex quantities,



it is readily shown that the respective current vectors in the star system of fig. 3 are as follows*:

$$\mathbf{I_R} = -j\left[\frac{\mathbf{V_{BY}} + 2\mathbf{V_{YR}}}{2/\omega C - 3\omega L}\right], \quad \mathbf{I_B} = \left[\frac{\mathbf{V_{BY}}}{2j\omega L} - \frac{1}{2}\mathbf{I_R}\right],$$

$$\mathbf{I_Y} = -\left[\frac{\mathbf{V_{BY}}}{2j\omega L} + \frac{1}{2}\mathbf{I_R}\right]$$

If the transformer shown in fig. 3 is only lightly loaded, the inductance L of each limb will be large and its value will be largely dependent upon the magnitude of the currents in the windings. Assuming that the line-supply voltage is 10 kV, the capacitive reactance $\frac{1}{\omega C} = 400$ ohms and the inductive reactance $\omega L = 150$ ohms, the vector diagram voltage across the respective core windings of the transformers are as shown in fig. 6. From this it will be seen that the *phase sequence of the voltage diagram has become reversed as compared with the phase sequence of the supply voltage.* The motors connected to the transformer will, therefore, run in the reverse direction and any lamps connected may be burnt out.

An oscillatory circuit of which the resistance R is small in comparison with the inductance L henry is shown in fig. 7. If the condenser of C farad capacitance is charged to a pressure of E volts and is then allowed to discharge through this oscillatory circuit,

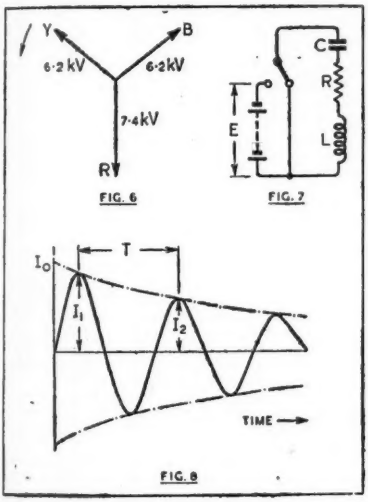


FIG. 6 FIG. 7 FIG. 8

* Symbols in heavy type denote vector quantities.

the current at any moment t will be (see fig. 8)

$$i = I_0\, e^{-\delta t} \sin \omega_n t \quad . \quad . \quad . \quad (1)$$

where $\omega_n = \sqrt{\frac{1}{L\cdot C} - \left(\frac{R}{2L}\right)^2} = \sqrt{\omega_0^2 - \delta^2}$ and is the natural frequency of the circuit. Also, $\omega_0 = \frac{1}{\sqrt{L\cdot C}}$: $\delta = \frac{R}{2L}$ so that when R is relatively very small $\omega_n \simeq \omega_0 = \frac{1}{\sqrt{L\cdot C}}$ and the periodic time is $T \simeq \frac{2\pi}{\omega_0}$ sec. Further, $\frac{I_2}{I_1} = e^{-\delta T} = e^{-\Delta}$ and $\Delta = \delta T = \log_e \frac{I_1}{I_2}$ so that, $\Delta = \pi R\sqrt{\frac{C}{L}}$ and is termed the "logarithmic decrement."

In the following table the leading relationships for such an oscillatory circuit are summarised, *viz.*:—

ω_0	f_0	T	Δ	λ_{cm}	μ
$\frac{1}{\sqrt{L\cdot C}}$	$\frac{1}{2\pi\sqrt{L\cdot C}}$	$2\pi\sqrt{L\cdot C}$	$\pi R\sqrt{\frac{C}{L}}$	$2\pi\mu\sqrt{L\cdot C}$	3×10^{10}cm.p.s.

where $10^9 L_{cm} = L$ henry, and $9 \times 10^{11} C_{cm} = C$ farad.

When the condenser in fig. 7 has become charged to E volts, the stored energy will be $\frac{1}{2}E^2C$ joules, and after one-quarter of a cycle the current will reach its first peak value I_1 that is to say, the whole of the electrostatic energy which was stored in the condenser will now have become transformed into the electromagnetic energy associated with the inductance. The peak value I_0 of the current

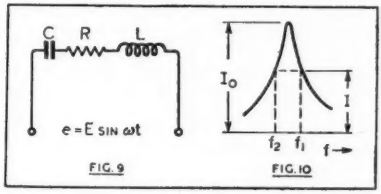


FIG. 9 FIG. 10

as shown in fig. 8 will then be given by the equation $\frac{1}{2}LI_0^2 = \frac{1}{2}E^2C$, that is, $I_0 = E\sqrt{\frac{C}{L}}$ and the expression (1) may now be rewritten

$$i = E\sqrt{\frac{C}{L}}\, e^{-\delta t} \sin \omega_n t \ldots\ldots (2)$$

If this damped oscillatory current is measured by means of a hot-wire ammeter, the heat effect of the current will be given by $\frac{H}{R} = \int_0^\infty i^2 dt \simeq \frac{I_0^2}{4\delta}$ where the resistance R includes the ammeter resistance. If there

are k such oscillatory discharges per second, the heating effect will be $\frac{H}{R} \triangleq k\frac{I_0^2}{4\delta}$ watts, and this will be the quantity which the ammeter will measure.

Example 1 :

If C=2,250 cm = 2.5×10^{-9} F : L=10^5 cm = 10^{-4} H : R = 20 ohms : E = 1,000 volts : then $\delta = 10^5$: $\omega_n \triangleq \omega_0 = 2 \times 10^6$: f_0 = 0.318×10^6 : T = 3.14×10^{-6} sec. : $\lambda = \mu T$ = 943 metres : $\triangle$ = 0.314 : I_0 = 5 amperes : $\frac{H}{R} \triangleq \frac{I_0^2}{4\delta} = 6.25 \times 10^{-5}$.

The energy which is dissipated in the resistance R is then $6.25 \times 10^{-5} \times 20 = 1250 \times 10^{-6}$ joules, which is equal to the amount of energy initially stored in the condenser.

Now suppose that the oscillatory circuit in fig. 7 is connected to an AC supply of voltage $e = E \sin \omega t$ as shown in fig. 9. The peak value of the current will then be $I = \frac{E}{\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}}$ amperes, so that when $\omega L = \frac{1}{\omega C}$, that is when $\omega = \omega_0 = \frac{1}{\sqrt{L.C}}$, the oscillatory circuit will be in resonance with the supply frequency and the peak value of the current will then be $I_0 = \frac{E}{R}$ amperes. It may then be shown that for any value of the supply circular frequency ω the corresponding peak value of the current will be given by the expression $\frac{I}{I_0} = \frac{\triangle}{\sqrt{\triangle^2 + \pi^2\left(\frac{\omega}{\omega_0} - \frac{\omega_0}{\omega}\right)^2}}$ or, alternatively,

$$\triangle = \pi\sqrt{\frac{I^2}{I_0^2 - I^2}}\left(\frac{\omega}{\omega_0} - \frac{\omega_0}{\omega}\right) \ldots\ldots (3).$$

If the supply frequency is now adjusted in turn to the respective values of f_1 and f_2 so that, in each case, the current has the same value, the conditions being illustrated in Fig. 10, then, by means of expression (3) and by substituting $\triangle = \pi R\sqrt{\frac{C}{L}}$ the value of the resistance will be given by $R = 2\pi L(f_1 - f_2)\sqrt{\frac{I^2}{I_0^2 - I^2}}$ and this result gives a means for measuring the high-frequency resistance of an oscillatory circuit.

Example 2: Taking the same values of the constants as given in Example 1 and assuming the peak value of the applied EMF is E= 1,000 volts, the resonance circular frequency will be $\omega_0 = 2 \times 10^6$ and the peak value of the current at resonance will be I_0=50 A, the voltage across the resistance will be 1,000 V, and the voltage across the inductance and across the condenser will in each case be $50 \times 2 \times 10^6 \times 10^{-4} = 10{,}000$ V.

If the supply frequency is now changed by + 2 per cent. so that $\omega = 2.04 \times 10^6$, then the impedance of the circuit will be $R + j\left(\omega L - \frac{1}{\omega C}\right) = 20 + j8 = 21.5\ e^{j21.6°}$ and the magnitude of the current will then be $I = \frac{1{,}000}{21.5} =$ 46.5 A. Hence $\triangle = \pi\sqrt{\frac{I^2}{I_0^2 - I^2}}\left(\frac{\omega}{\omega_0} - \frac{\omega_0}{\omega}\right) =$ 0.314. The power supplied to the circuit will then be $\frac{1}{2} \times \frac{1000 \times 46.5 \cos 21.6°}{1000} =$ 21.6 kW, and the reactive power will be $\frac{1}{2} \times \frac{1000 \times 46.5 \times \sin 21.6°}{1000} = 8.6$ kVA. At resonance, however, the power supplied to the circuit will be $\frac{1}{2} \times \frac{1000 \times 50}{1000} = 25$ kW, whilst the reactive power, of course, will be zero.

Ontario Power Shortage

Restrictions in the Autumn

A COMPLETE black-out every night if necessary to alleviate the power shortage was urged by Lieut.-Col. George A. Drew, Conservative leader, speaking in the Ontario Legislature on April 8th. Col. Drew quoted a Washington dispatch in which it was said that Canada had advised the United States that it had not enough power for the manufacture of aluminium, magnesium, and newsprint needed by the United States. If this report was correct, and no doubt it was, they were faced with an extremely critical situation, he said. If a black-out were necessary to meet the situation they should have it, for their very lives were at stake. He suggested that the Hydro-electric Power Commission should take a stand independent of the power controller and advise industries manufacturing non-essential articles that there would be no more power available for them. Now was the time for Ontario to show that it was prepared to act and give the whole country the necessary leadership that would bring about a sense of the deep real danger.

Mr. W. L. Houck, vice-chairman of the Commission, said that it was in the hands of the power controller and was prepared to co-operate with him to the limit. He assured the Opposition leader that the Commission was prepared to take care of the loads for any war plants. Earlier he had announced that restrictions on the use of power would definitely come into effect early in the autumn. These would consist of banning the use of illuminated signs; reduction in street lighting and an educational campaign to show the users how and when to conserve power. The sale of new water heaters had already been stopped. The replacement of 60-W lamps by 25-W types would be urged.

According to Dr. T. H. Hogg, chairman and chief engineer of the Ontario Commission, it may be possible to save some 150,000 HP initially under the coming restrictions. That saving, together with additional power from new sources, will, he believes, enable the Commission to meet the 1942 shortage, which is put at between 150,000 and 300,000 HP.

Switchgear Progress

The Basis of Present Technique

By R. T. Lythall,
A.M.I.E.E., A.Am.I.E.E.

IT is both interesting and instructive for a young engineer steeped in present-day methods to consider the very real progress which has been made since the days, not so many years ago, when pioneers were indicating the need and the possible methods of establishing certain essential features of switchgear design, application and proving. By reading some of the papers presented, he will gain an idea of the trend of thought then and now, taking note of the arguments of those participants in the discussions who have laid the foundations for much of our present technique.

As a measure of the progress made, and to show how present technique was initiated, the author recalls the views expressed at an I.E.E. meeting seventeen years ago

An outstanding example was the paper on "The Design of Electrical Plant, Control Gear and Connections for Protection against Shock, Fire and Faults" (*I.E.E. Journal*, Vol. 63, No. 341) which was read before the Institution of Electrical Engineers in 1925 by the late Mr. H. W. Clothier, who by his individual work and by contributions both to the I.E.E. proceedings and to the technical Press was a major influence in the progress of switchgear design and testing.

This paper, briefly, had three main purposes: (1) To further the author's advocacy of the metalclad construction of switchgear as a requisite for safety and continuity of supply; (2) to suggest the need for some standard method of determining and proving the breaking capacity of circuit-breakers; and (3) to consider forms of protective gear for the better safeguarding of electrical plant.

Each of these purposes has since been achieved to a very considerable degree, but in discussing here the progress made during the first seventeen years only (1) and (2) are considered.

Metalclad Gear

Mr. Clothier was perhaps best known as an early exponent of metalclad construction. Mr. E. B. Wedmore, in opening the London discussion, said: "The adoption of the principles underlying the metalclad construction is in a large measure due to the author's personal effort." To-day practically every switchgear manufacturer (including those who formerly opposed this type) has designs of metalclad gear. It has, as a type, been extended to the higher voltages (66 and 132 kV) and has been used to form the basis of the modern unit comprising low-oil-content circuit-breakers.

Mr. Wedmore, however, with others, disagreed with the views expressed concerning duplication, particularly of bus-bars. Mr. H. Trencham, for example, considered that "the single bus-bar does not provide a sufficient margin of safety" and that "a duplicate bus-bar has quite a number of useful functions in connection with the operation of electrical systems and will remain." And Mr. S. Ferguson argued that "the bus-bars in a central station are the most immune from failure, and yet I consider that there is the greatest necessity for their duplication because of the consequences involved in a breakdown."

This arose because Mr. Clothier questioned the real need for duplication of bus-bars or circuit-breakers. His argument was that there were few occasions when duplicate bus-bars were advantageous and that two out of four of the occasions he named were eliminated by the use of metalclad gear. He claimed that the need to change over from one set of bars to another while the circuit was alive was often more imaginary than real.

On-load Selection

To-day, as we know, on-load selection as between bus-bars, and indeed the use of duplicate bus-bars, is common and the times or situations of their use are generally recognised. Nevertheless, Mr. Clothier served an excellent cause by drawing attention to certain dangers which existed and which have now been largely taken care of. But one point still remains an open one as between those who are prepared to regard any danger as remote and those who will not even consider the arrangement. It is the question of the desirability of bringing the two sets of bus-bars together at a common point, *i.e.*, in an oil-immersed selector-switch chamber.

There were those who complained that Mr. Clothier had dealt only with the advantages of metalclad construction and the disadvantages of cellular and cubicle types and had not reversed the process. Mr. P. B. Hall, for example, objected to "the assumption that the air-insulated types or, in other words, the cubicle and truck types, are a half-way measure." Mr. A. Bannister agreed that the growth of metalclad switchgear had

been due to the space limitations imposed on switchgear designers by those responsible for station lay-outs, particularly in reference to getting a quart into a pint pot. This point was made several times during the discussion. Unfortunately it is one on which, even to-day, we have not made sufficient progress, particularly in industrial plants. Mr. Clothier claimed the " distinct inaccessibility of every conductor " in metalclad filled gear as an advantage. This, said one speaker, was not necessarily the case and this argument is still used to-day.

Mr. Bannister doubted the practicability of metalclad switchgear for voltages over 35,000 " until our knowledge of solid dielectrics and the voltage stresses therein under operating conditions is increased." Now, at least one installation exists for a voltage of 132 kV, and a number at 66 kV, indicating that the knowledge considered necessary has been acquired.

Breaking-Capacity Rating

It is under the heading of proving breaking capacity that one sees greatest progress. At the time of Mr. Clothier's paper the current British Standard Specification No. 116 was dated 1923. How incomplete that issue was (and indeed the later issue of 1929) can best be judged by comparison with the 1937 edition. In the former issues, little or no information was given to help either the maker or user to judge accurately the merits of any assigned rating. Mr. Clothier realised this. He pointed out that " performances of circuit-breakers have had in the main to be gauged from experience in places where they have been overloaded under short-circuit conditions." How to predetermine the rating to assign to any given circuit-breaker was clearly a matter in the hands of the maker and his doubts may have depressed the value or his anxiety to sell in a competitive market may have inflated the value. But in neither case could the value be effectively proved and one man's word was as good as another's.

While the early Specification acknowledged the temporary high value of short-circuit current, it required " due account " to be taken of reduction in the current to be broken as affected by the time characteristic of the circuit-breaker and relays. In doing so, the B.S.S. admitted a worst condition of twenty times normal, but suggested six times as the value for the breaker rating. Mr. Clothier did not think this sufficient and suggested a compromise of ten times. Thus decrement was permitted to enter into the rating necessary for any given circuit. Modern practice is to ignore it, as reference to B.S.S. 116-1937 will show.

Mr. Clothier discussed arc energy problems in relation to the work really to be done in clearing the circuit and said " of course the way to rate any article is to base its performance upon some unalterable standard."

There, then, is the lead given to the present " unalterable standards " — standards far more severe than those envisaged by Mr. Clothier, who, at the time, said nothing about power-factor *standards*, symmetrical and asymmetrical values, of DC components, of the ability of the breaker to clear faults of values *lower* than the rating and, most important, of *making* values.

Mr. Wedmore, in the discussion, noted how a switch, clearing a circuit on one occasion, might be blown to pieces on the next occasion. He went on to say that a suggestion made that testing a given breaker six times should prove its rating was insufficient with the designs then available. He believed this question to be one " upon which a great deal will be said in the next few years " and " we are in sight of a formula which will enable us to establish on scientific principles the true rupturing capacity of an oil circuit-breaker." Mr. Wedmore's doubts on the number of tests may be compared with present requirements of three tests each at 10, 30, 60, and 100 per cent. plus a 100 per cent. asymmetrical test. His scientific formula cannot be so compared. The only " formula " yet is proving at a specially designed short-circuit testing station.

Power Factor

Dr. C. C. Garrard stated that " it may be necessary in the future when specifying breaking capacity to specify the power factor, but we are hardly in that position yet." Mr. Trencham also mentioned power factor and continued " it is very unfortunate for the industry, particularly in this country, that very little real testing apparatus has been available. I think that one of the essential things for the switchgear industry to attend to now is to see that investigations are made with short-circuits much more comparable with those which occur in large power systems." How that " thought " has been accomplished is well known to-day.

Mr. D. R. Davies pointed to the fact that even those who were in the fortunate position of also making large machines could only rely on a maximum of 200,000 kVA being available, obtained by short-circuiting a commercial machine while on the test bed. And so on right through the discussion and answer. But perhaps the most significant remark was one made by Mr. Clothier in replying to the discussion, which reads:—

" Mr. Ratcliff draws attention to the elastic nature of statements about breaking-capacity ratings; and this coming as the declared opinion of a large user, notwithstanding the existence for two years of the British Standard Specification, indicates a state of affairs which calls for some explanation. Dr. Garrard fears that my

approach to the subject will harm British reputation. British reputation is not made by the B.E.S.A. but by the results of the work produced under their recommendations. Dr. Garrard says that the breaking capacity of the switch must generally be in 'inverse ratio to the reputation of the maker.' Surely if that be so, it is in the interest of the whole country to declare a better standard. Anyhow, it should be definite."

That better standard has been declared in B.S.S. 116–1937. British reputation was not harmed. Instead, these early discussions have led directly to a position where it may be stated that this country stands second to none in its research into circuit breaking and making problems, and, what is more important, in the standards it recognises. In accepting the I.E.C. document in its entirety as the basis of B.S.S. 116–1937, Great Britain imposes conditions which no other country has yet done, in spite of the fact that the I.E.C. Publication 56 is the result of the work of all nations. It is to our credit that the I.E.C. document was considerably influenced by British views, views which go back to those expressed as a beginning by Mr. Clothier and those who contributed to the discussions of his papers.

Power from Streams

Investigating Small Hydro-electric Schemes

By J. L. Gaved

IN normal times low-power hydro-electric schemes rarely warrant the usually high capital outlay, chiefly because they are remote from the centre of utilisation. When, however, alternative fuels are not obtainable in adequate quantities there is an incentive to harness water-power reasonably adjacent to the premises requiring a supply of electricity.

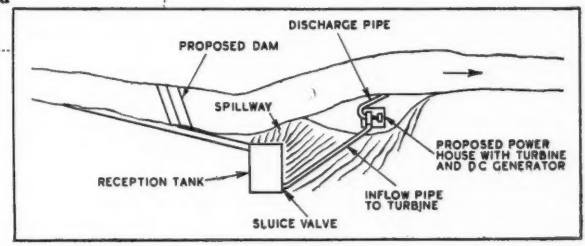
In a recent typical example two farmers found themselves seriously handicapped by difficulty in securing fuel oil for their oil engines and sought technical advice regarding the possibility of employing power derived from a stream separating their properties and an investigation was carried out.

An example is given of a survey undertaken to determine the potential power available from a small stream. This proved inadequate, but the author suggests that somewhat broader watercourses might yield fruitful results

In such cases it is first of all necessary to ascertain whether, unknown to the prospective user, the stream is subject to the control of a catchment authority without whose consent any interference with its flow or its diversion is impermissible. In general it may be taken as lawful for the owner of land through which a stream is flowing to use the water for his own purposes so long as he does not divert it for sale to another or extract such quantities as may prejudice the interests of others downstream. A mill, for example, might well be rendered uneconomic owing to a reduction of the volume of water.

It is extremely doubtful whether the type of power plant discussed in this article would involve any legal obstruction as there is no intention to abstract the water. The power contained in its regulated flow is the sole aim in view.

Assurance having been received that it was in order to proceed with the investigation, a survey of the stream, both ocular and instrumental, was made. In the case under review it was accomplished with the aid of a standard level and staff, the levels being recorded over the full length of half a mile, while observation revealed the points at which the condition of the banks appeared to indicate the most promising situation for a dam. After selecting the most suitable point



General layout of scheme

(fig. 1) preparations were made to measure the flow volume in the following manner.

A pit was excavated in the clay subsoil, carefully levelled in the bottom and trimmed to measure 12 ft. by 8 ft. by 1 ft. 6 in. deep, so that when completed the narrow channel connecting to the stream would admit exactly the quantity of water contained by one sq. ft. section of the whole cross-sectional area of the stream, the surface of the water in the pit, when full, being arranged to coincide with that of the stream.

The pit being filled to a depth of one foot, the volume of the content was $96 \times 6{\cdot}25 =$ 600 gal. This pit was flooded at a predetermined time and the period measured by stop watch. It was ascertained that the 600 gal. flowed in 65 sec.

The next step was to ascertain the total cross-sectional area of the stream at the significant point above the entrance to the filling channel of the pit (fig. 2). This was recorded by a series of soundings to total 12 sq. ft. Hence total flow of the stream at the prevailing winter level amounted to

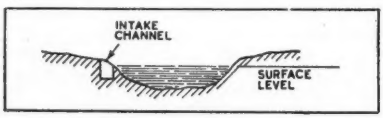
$$\frac{600 \times 60 \times 12}{65} = 6{,}646 \text{ gal. per min.}$$

Reasons for Method

This method of measuring the flow of water was selected for two reasons. The pit as excavated would eventually provide a reception tank, from whence the inflow pipe for the power unit selected would issue. Alternative means of flow measurement by gauge board involved a complete dam across the stream. Simplification of method may have sacrificed accuracy to some extent, but saving in time and expense, together with the ultimate utility of the pit warranted this procedure.

The calculated flow of 6,646 gal. per min. also yielded a fair estimate of the velocity of the stream at 88 ft. per min. which was useful data should consideration be given to waterwheels as the power unit.

Reference was now made to the profile



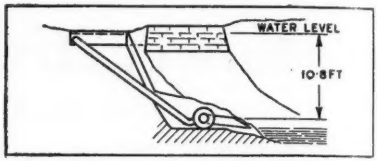
Section of stream above dam

obtained by the survey of the stream and from the pit or reception tank; a fall of 10 ft. was the maximum attainable to the site of the power plant. This site was fortuitously a flat bay in one bank of the stream 25 ft. below the tank and eminently suitable for the erection of a shed to house the machinery. An important consideration here was the maintenance of the hydraulic head of 10 ft. in flood conditions, for any rise of water level below the discharge pipe of the turbine or waterwheel sluice would naturally reduce this substantially.

With 6,646 gal. of water available per min. and a static head of 10 ft., the equivalent hydraulic pressure was 5 lb. per sq. in.

An assumption for convenience of rating was made of an inflow pipe to a water-turbine having an area of 1 sq. ft. approximating to 14 in. diameter. The total force available was, therefore, $144 \times 5 = 720$ lb.

The velocity of 6,646 gal. per min. pouring through this pipe would be equivalent to 1,056 ft. per min., which would normally have



Relative levels of dam, tank and turbine

to be discharged from the impounded water behind the proposed dam; otherwise there would be a waste over the top of the breastwork. The potential horse-power at the intake pipe would therefore equal

$$\frac{720 \times 1{,}056}{33{,}000} = 23 \text{ HP gross.}$$

A check calculation from an empirical figure of 8·8 cub. ft. per sec. per 1 ft. head as productive of 1 HP gives

$$\frac{1{,}056 \times 10}{8{\cdot}8 \times 60} = 20 \text{ HP.}$$

It was considered prudent to assume the lower figure since winter flow had been measured. Although summer flow was reputed by local knowledge as "not much less" this could not be accepted as adequate data!

Demand and Supply

The electrical demand for each farm, in amperes, was calculated from the following schedule:—Two 5-HP motors, 20; 6-kW cooker, 25; heating circuit, 10; lighting circuit, 10; total, 65.

On the assumption of a voltage of 460 and transmission by overhead line, in each instance some 600 yd., using a three-wire DC system, the power available was inadequate even for the electrical requirements of only one farmstead.

The investigation consequently resulted in a recommendation adverse to the high hopes which had been initially raised. This record, however, concerns a very small stream, and, calculating from the data given, the hydraulic power of broader rivers may be found to yield more fruitful results.

CORRESPONDENCE

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for correspondents' opinions.

Heating Large Buildings

ELECTRICAL energy can be sold cheaply for heating only so long as it is an off-peak demand, but it would not require many thermal storage plants in one city for the "off-peak" demand to exceed the maximum load for other purposes.

Coal is not being put to the best use when some 40 to 50 per cent. of its heat energy goes to waste in rivers and cooling towers. This is largely inevitable in summer, but not in winter. In any large building, space has to be set aside for essential services. Usually the electricity authority requires a transformer room, and in addition a large room for the central heating plant.

Supply authorities should negotiate contracts for both electricity and heat in these buildings and take over the central heating plant, installing magazine-type steam boilers with automatic feed and generators driven by pass-out turbines. The undertakings could staff these small power stations during the winter months and the load generated would be a valuable relief to the load on the central stations. The exhaust steam would be used for heating or any other process requiring steam. The staff could be utilised in the summer on overhaul or even on mains work. Probably the people responsible for managing the large buildings would be only too pleased to contract out of the maintenance of the heating plant.

Another point in favour of the scheme is that transforming sites are difficult to get nowadays, and it is easier to persuade an architect that space is needed for central heating plant than for a transformer. When not generating, these small stations would provide valuable distribution points for the local mains.

The answer to the objection that products of combustion would be discharged over the centres of cities instead of at the remote site of the main generating station, is that owners of most buildings would have their own boilers anyway, except in the unlikely event of electric heating becoming compulsory by law. What is more, if the supply authority controlled the combustion there would be far less smoke nuisance than at present.

In at least one large department store in London the exhaust steam from turbo-alternator plant heats the building. The store engineer operates the generator by arrangement with the local electricity authority, which asks him to do so only at the time of the peak demand on its bulk suppliers. The store engineer makes the minimum use of his generating plant, thus keeping down maintenance and at the same time avoiding large minimum-demand charges. The local undertaking sells a maximum of kWh to the store and saves on the maximum demand payments to the bulk supply authority.

Sanderstead. D. E. GOUGH.

Significance of "j"

REGARDING Mr. Roehmann's letter in your issue of May 1st, I have suggested on previous occasions that the unit angle be a "rev" of 360 deg., divided into 1,000 "millirevs" which may be called "jots." Any angle is given by 1^n where n denotes the amount of rotation of the vector of unit length, termed a "revor," so that 1^0 is the initial position and 1^1 is rotation round to the initial position. Instead of the clumsy terms "clockwise and counter-clockwise" I suggest "right and left turn." The revor has a half arrow head, the direction of rotation being shown by the position of the half arrow.

Many things follow from this simple plan. If two vectors A and B at angles 1^m and 1^n are multiplied together one gets $A.1^m.B.1^n = AB.1^{m+n}$, the lengths being multiplied together and the angles added. In fact the system is a polar form of the a+jb method, and theorems proved in one may be transformed into the other system, often with a great saving in labour. Thus, to prove De Moivre's theorem, if 1^m is a revor at an angle θ, 1^{mn} gives the angle $n\theta$. Hence 1^m is the polar form of $\cos\theta + j\sin\theta$ and $(1^m)^n$ of $(\cos\theta + j\sin\theta)^n$. But $(1^m)^n = 1^{mn}$ and hence $(\cos\theta + j\sin\theta)^n = \cos n\theta + j\sin n\theta$.

A very important fact appears. We get rid of the ambiguity that if $x^2 = 4$, $x = \pm 2$. What really happens is this. If $x^2 = 1^0 \times 4$, $x = (1^0 \times 4)^{\frac{1}{2}} = 1^0 \times 2 = +2$ and $(1^1 \times 4)^{\frac{1}{2}} = 1^{\frac{1}{2}} \times 2 = -2$. The use of the plus or minus sign depends on what one starts with and one can work out a long set of equations and know at the end precisely what the result will be without any ambiguity. Similarly the cube roots of 1 are 1^0, $1^{\frac{1}{3}}$ and $1^{\frac{2}{3}}$ which are at angles of 0, 120 and 240 degrees, which, expressed in the a + jb form, give the roots as generally stated. The graphing of imaginary curves becomes simple.

In $y = \sqrt{-x} = (1^{\frac{1}{2}}x)^{\frac{1}{2}} = j\sqrt{x}$, the ordinate may be supposed to be turned at right angles to the plane of the paper. One may, however, suppose that the ordinate is measured along 0z and turned round by j into the plane of the paper which gives the imaginary curve on the paper. For many years I have been

pointing out that in conic sections, one should place cones on the three axes, x0x, y0y and z0z. Then if one cuts a circle (or ellipse) off one cone one cuts hyperbolas from the other four cones. These are the so-called imaginary curves, which are quite real and not imaginary at all ; they are given by the equations $y = j(x^2-1)^{\frac{1}{2}}$ and $x = j(y^2-1)^{\frac{1}{2}}$.

Tynemouth. C. TURNBULL, M.I.E.E.

Mains Salvage

CONSIDERABLE amounts of metal are used in the moulding of various types of straight-through and tee-joint boxes and I believe that a substantial contribution may be made by mains departments to the salvage campaign. Apart from the difficulty of securing various types of boxes at present, and delay in delivery, consideration should be given to alternative mechanical protection of joints in general.

Comparing favourably with cast-iron boxes in these times are sleeves and butterfly or tee boxes knocked out of sheet lead or cast-lead sleeves and tees filled with resin oil or compound with a bitumen content. Mechanical protection can be obtained by levelling the ground to the bottom of sleeve with soft soil and placing six or eight old bricks round the joint and covering it with a concrete slab of suitable size. The bricks can be padded round with soft soil and the whole filled with a rough compound recovered from old joint casings. Greater use of breeches or " Y " joints when occasion permits will result in considerable saving in many ways. Certain types of dividing boxes can be replaced by lead sleeving, cable cores being brought through and empire taped or " Sistoflexed.". Easy methods of fixing can readily be adopted for these sealing heads. The above methods are suitable for any joints up to 11-kV.

Northampton. CAIRNGORM.

Inductance Formulæ

IN a very useful pocket-book entitled the " Electrical Engineers' Companion " published by the London Electric Wire Co. and Smith's, Ltd., the following formulæ are given on page 39 for the inductance in millihenrys per mile of a pair of overhead wires each of radius r and distance apart d:

$1.482 \log_{10} (d/r) + 0.161$ for solid round wire
$1.482 \log_{10} (1.378\ d/r)$ „ 7 strand
$1.482 \log_{10} (1.320\ d/r)$ „ 19 „
$1.482 \log_{10} (1.302\ d/r)$ „ 37 „
$1.482 \log_{10} (1.295\ d/r)$ „ 61 „

It is unfortunate that the formulæ are given in this way, for at first sight it would appear that the effect of stranding is to do away with the second term 0.161 in the expression for the solid round wire, which term covers the effect of the flux inside the wire itself. As a matter of fact, the formulæ for the stranded wire have evidently been collected from a different source and are given in a different form in which the 0.161 is incorporated under the logarithms : $1.482 \log_{10} (d/r) + 0.161 = 1.482 [\log_{10} (d/r) + 0.1085] = 1.482 [\log_{10} (d/r) + \log_{10} 1.284] = 1.482 \log_{10} (1.284\ d/r)$.

It is seen, therefore, that as the number of wires is increased the formulæ approaches that for the solid wire. All the formulæ can be expressed as the sum of two terms like that for the solid wire, the second term being always 0.161 since this is independent of the size of the wires or their distance apart. It is only necessary to replace the radius in the solid wire formulæ by a value somewhat smaller than the overall radius of the stranded wire, the actual ratio being 0.933, 0.973, 0.986 and 0.992 for 7, 19, 37 and 61 wires respectively.

Can any reader say who first worked out the formulæ for the inductance of these stranded wire lines? I have checked the value for 7 strands and found it quite correct.

Glasgow. G. W. O. HOWE.

Fuel Rationing

IN the House of Commons on May 19th, Lord Winterton asked the President of the Board of Trade if he was aware that there was, during the hours of daylight, an unnecessarily lavish use of electric light in railway stations, hotels, clubs and other large public buildings in London, and if he would take steps to prevent this by the issue of regulations under the Emergency Powers Act. Further to this Major Lyons asked what steps had been taken to stop unnecessary consumption of light in hotels, restaurants, shops, flats and the like, and whether Mr. Dalton would issue specially directed requests by radio or otherwise.

Mr. Dalton said he was aware that there was still extravagance in the lighting of various classes of premises. He had already made an Order, which came into force the previous day, prohibiting lighting for purposes of advertisement, and he was now considering, in consultation with representatives of the interests concerned, restriction by Order of interior lighting of public and other premises. The need for economy in lighting had already been the subject of extensive publicity.

Miss Ward asked the President of the Board of Trade if he had received from fuel overseers and gas and electricity undertakings the estimated number of permanent additional staff they would require to carry out fuel rationing efficiently.

Mr. Dalton replied that he had taken steps to ascertain the views of the people mentioned on the additional staff required.

Mr. Bossom asked the Minister of Information whether he would consider having the last news bulletin broadcast at 11 p.m. instead of midnight in order to save coal, electricity and gas.

Mr. Thurtle, who replied, said that hitherto it had not been thought worth while to make such a change in view of the relatively small saving in fuel which would be achieved, but the Ministry was asking the B.B.C. to reconsider it.

PERSONAL and SOCIAL

News of Men and Women of the Industry

THE Council of the Institution of Electrical Engineers has announced its nominations for the vacancies which will occur on the Council on September 30th next. **Prof. C. L. Fortescue, O.B.E., M.A.,** has been nominated as president. As Professor of Electrical Engineering at the City and Guilds College, South Kensington, he is well-known, and he has contributed valuable work in the development of wireless telegraphy. The new vice-president is **Mr. P. Good,** C.B.E., Director of the British Standards Institution, and **Mr. E. Leete,** a director of the London Electric Wire Co. & Smiths, Ltd., has once again been nominated as hon. treasurer.

The nominations for ordinary members of the Council are as follows:—Members: Prof. J. D. Cockcroft, M.A., Ph.D., M.Sc.Tech., F.R.S., Professor of Natural Philosophy, The University, Cambridge (at present Chief Superintendent, A.D.R.E., Ministry of Supply); Mr. A. J. Gill, B.Sc.(Eng.), Assistant Engineer-in-Chief, General Post Office; Mr. D. B. Hoseason, director in charge of Electrical Departments, Brush Electrical Engineering Co., Ltd.; Dr. A. H. Railing, D.Eng., vice-chairman, General Electric Co., Ltd; Mr. E. A. Reynolds, M.A., principal, Reynolds and Bradwell; and Mr. H. W. H. Richards, chief electrical engineer, L.N.E. Railway.

The nominee to represent Associate Members on the Council is Mr. J. M. Fleming, M.A., B.Sc.Tech., technical expert, B. S. & W. Whiteley, Ltd., and Associates are represented by Mr. C. W. Bridgen, general sales manager, Ferranti, Ltd.

Sir Kenneth Lee has been appointed Director-General of Raw Material Controls in place of Sir George Beharrell who has resigned on account of ill-health.

Mr. A. W. B. Ferguson, who has for many years been active in the field of steam generation, joined the staff of Mitchell Engineering, Ltd., on May 4th.

The president of the Institution of Engineers, Australia, for 1942 is **Mr. W. E. Bassett,** M.C. Mr. Bassett is a Bachelor of Electrical Engineering of Melbourne University and has been in consulting practice in mechanical and electrical engineering since 1929. He served in the Australian Engineers and Flying Corps during the last war.

In recognition of the services of **Prof. H. W. Price,** head of the Department of Electrical Engineering at the University of Toronto, the Hydro-Electric Power Commission of Ontario has endowed a fellowship in electrical engineering at the University, in the capital sum of $10,000. Prof. Price, with the assistance of Mr. C. Kent Duff, made exhaustive inquiries into the control of the frequency of an electric power system and designed automatic regulation equipment which was constructed in the Commission's workshops in 1934 and has proved satisfactory in every way. For this work Prof. Price refused to accept any financial compensation, and it has accordingly been decided to establish the fellowship, which is to be named after him.

Following upon the resignation of **Mr. S. Ferguson** from the position of managing director of Ferguson, Pailin, Ltd., as reported in our last issue, the company has appointed **Mr. G. A. Cheetham** as managing director and **Mr. J. R. Wilkinson** as a director and sales manager. Mr. Cheetham has for many years been chief engineer and superintendent of the Meter and Instrument Department of the Metropolitan-Vickers Electrical Co., Ltd. and Mr. Wilkinson has been in charge of the London office of Ferguson, Pailin, Ltd., for the past thirteen years. Mr. Wilkinson's headquarters will in future be at the Ferguson Pailin works at Higher Openshaw.

Mr. T. Riley, who has served in the Electricity Department for over thirty years, has been recommended by the Burnley Electricity Committee for the appointment of deputy borough electrical engineer in succession to Mr. T. B. Nutter, who was recently appointed engineer on the retirement of Mr. J. E. Starkie.

Mr. J. S. Nicholl, C.B.E. (chief executive officer, McNamara & Co., Ltd.), has been re-elected president of the Institute of Transport for the year 1942-43. The Council of the Institute has appointed **Mr. F. W. Crews** secretary. Mr. Crews joined the staff of the Institute in 1927, was appointed assistant secretary in 1935, and has been acting secretary since the retirement of Mr. A. Winter Gray last year.

Mr. H. J. Norton, A.M.I.E.E., who has been hon. secretary of the South Wales Branch of the Association of Mining Electrical and Mechanical Engineers for the past twenty years, was elected branch president at the recent annual meeting.

Mr. R. L. Wood has been elected president of the Midland Branch of the Association of Mining Electrical and Mechanical Engineers.

The Stirling Corporation Electricity Undertaking Committee at its last meeting considered a letter from the Electricity Commissioners, who stated they felt that in view of the desire of **Mr. W. R. Murray** (the electrical engineer) to leave for health reasons he should be allowed to do so. Having discussed the position with Mr. Murray, the Committee unanimously requested him to reconsider his decision to retire in September next. Mr. Murray agreed to do so, and to continue with the Town Council for another year. The Council, at a special meeting, approved this extension of service.

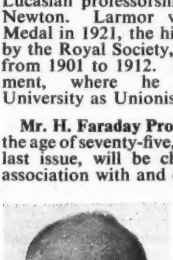
The Court of Governors of Manchester University has approved a recommendation that the honorary degree of M.Sc. should be conferred upon **Mr. G. E. Bailey.** Mr. Bailey, who was recently awarded the C.B.E., is a director of Associated Electrical Industries, Ltd., Metropolitan-Vickers Electrical Co., Ltd., British Thomson-Houston Co., Ltd., and other companies. He is also president of the engineering and Allied Employers' National Federation.

Obituary

Sir Joseph Larmor, whose death on May 19th, in his eighty-fifth year is reported from Holywood, County Down, was one of the great Victorian mathematical physicists whose work has influenced present-day thought. His most notable contributions to science are to be found in his "Æther and Matter" (1900), where he developed the theory of the electrical structure of matter, deducing from accepted electro-magnetic principles that a moving particle would suffer contraction in the direction of its line of motion. This formed the basis of the later theory of relativity. Larmor also propounded the para-magnetic theory of precession which bears his name. This postulated that the axis of an electron movement in a magnetic field would sweep out the curved surface of a cone round the direction of the field with a frequency proportional to the field strength.

He was born in Antrim and received his early education in Belfast, graduating at Queen's College, Belfast, whence he went to St. John's College, Cambridge. He took the mathematic tripos in 1880, being Senior Wrangler at the same time as Sir J. J. Thomson was Second Wrangler. For the next five years he was Professor of Natural Philosophy at Queen's College, Galway, before returning to St. John's Cambridge. In 1903 he was appointed to the Lucasian professorship, once held by Sir Isaac Newton. Larmor was awarded the Copley Medal in 1921, the highest distinction bestowed by the Royal Society, of which he was secretary from 1901 to 1912. In 1911 he entered Parliament, where he represented Cambridge University as Unionist for eleven years.

Mr. H. Faraday Proctor, whose recent death at the age of seventy-five, was briefly recorded in our last issue, will be chiefly remembered for his association with and development of the Bristol electricity undertaking (of which he became general manager) and his work for the I.M.E.A. He was one of the early figures in the electricity supply industry and was chief assistant engineer at Newcastle-upon-Tyne at the commencement of that undertaking in 1889. He went to Bristol in 1892, and in the following year a supply of electricity was given to the Bristol Arts and Crafts Exhibition from the Temple Back works. Subsequently the Feeder Road power station was commissioned and the station at Portishead was put into commission in 1929. He retired from the position of general manager at Bristol in November, 1932.



The late Mr. H. Faraday Proctor

He was a member of the I.M.E.A. from its inception, being a member of the Council from 1896 to 1930, president in 1898-99, hon. secretary from 1906 to 1919, and honorary treasurer in 1919-30. In recognition of his work for the Association he was elected an hon. member in 1933. He was also an active member of the I.E.E., being elected to the Council in 1910, on which he remained for eight years. He was chairman of the Western Centre in 1913.

Mr. C. W. Cox.—We regret to announce the death of Mr. Charles W. Cox, A.M.I.E.E., managing director of the Castle Fuse & Engineering Co., Ltd., at the age of eighty-eight. He had been associated with the electrical industry for over sixty years, and until a year ago he had been actively engaged in the manufacturing side. For many years he acted as district superintendent for the Edison Swan Co., and later as their branch inspector. In the early days (about 1885) he was responsible for the electrical equipment of one of the first submarines which was tested on Merseyside. He was interested in the design and manufacture of Ruhmkorff coils, and forty years ago he made up a coil of this type with a 60-in. spark. In later years he devoted his interest to fuses, particularly of the cartridge type. He was one of the founders of the Castle Fuse & Engineering Co., in 1925, and it was largely upon his patents and ideas that the business has been developed.

Mr. E. Hesketh.—We regret to record the death of Mr. Everard Hesketh, the refrigeration engineer, which occurred on May 18th at Johannesburg at the age of eighty-eight. Mr. Hesketh was educated at Marlborough and King's College, London, and served his apprenticeship with Easton & Anderson at Erith. The whole of his working life was spent with J. & E. Hall, Ltd., who he joined in 1878 as a draughtsman. The Dartford works had then passed out of the hands of the Hall family, by whom they were established in 1785, and he came into control of them in 1879, being a director from 1879 to 1932 and chairman from 1880 to 1921. Under his direction the manufacture of refrigeration machinery was introduced and subsequently the company widely extended its manufactures in this field. Mr. Hesketh was a member of the Institutions of Civil and Mechanical Engineers.

Mr. J. H. Hindle.—The death occurred recently of Mr. John H. Hindle, of Blackburn, governing director of Hindle, Son & Co., Witton, and a pioneer in the design of electric cranes, lifts and control gear.

Mr. A. W. H. Evans.—The death is announced, following a long illness, of Mr. A. W. Howard Evans, manager of the Birmingham depot of Ensign Lamps, Ltd.

Mr. W. P. Lamb.—The death occurred suddenly on May 14th of Mr. W. P. Lamb, civil engineer to the Mitchell Engineering, Ltd.

Mrs. T. A. Long.—The many friends all over the country of Mr. T. A. Long, M.I.E.E., managing director of Bonar, Long & Co., Ltd., will be sorry to hear of the death of his wife, which occurred on May 15th at Newport, Fife, after a long illness.

Dr. H. A. Des Vœux.—The death occurred at Bottramley Close, near Lymington, Hants, on May 20th of Dr. Harold Antoine Des Vœux, founder and president of the National Smoke Abatement Society. He was eighty-one years of age.

Will.—**Mrs. L. V. Esson,** widow of Mr. W. B. Esson, M.I.E.E., left £15,482, with net personalty of £15,282. Among her bequests was £1,000 to the I.E.E. Benevolent Fund.

E.A.W. Conference

Present Activities and Post-war Reconstruction Discussed

THE contribution of women in general and members of the Electrical Association for Women in particular, both during the war and in planning the reconstruction that will follow, was the principal theme of the Association's annual conference held on Thursday last week at the Institution of Electrical Engineers, London. Opening the function the President, the Dowager Lady Swaythling, commented on the remarkably large numbers of delegates attending and declared that the work of the Association seemed to grow every year both in quantity and quality.

In presenting the annual report of the National Executive Committee, the Director, Miss Caroline Haslett, C.B.E., pointed out that while on the surface it might appear that "business as usual" was the guiding principle, perusal of the report would reveal that the Association's activities had often been transformed to meet wartime needs and that special wartime departments had been set up. The E.A.W. had in fact developed into a centre for the distribution of information on many and varied phases of women's work.

Following Mr. J. R. Beard's address, "Looking Forward," at the Nottingham Conference last year, the Association had directed its attention to problems of reconstruction with particular reference to education and careers, housing, kitchen planning and equipment. Study sheets had been prepared and were now being used in the branches as a focus of thought, the results of which would be incorporated in a report by the Association. The hope that the study sheets would prove of interest to other organisations had already been realised.

The Rt. Hon. R. A. Butler, President of the Board of Education, addresses the Conference. On his left are Lady Swaythling and Miss Haslett

The Home Workers' Course, one of the purposes of which was the intelligent use and maintenance of domestic electrical equipment, had special significance during wartime and classes were more numerous than in 1940. The E.A.W. fleet of mobile canteens had received additions during the year and continued to play a vital part in the alleviation of some of the hardships undergone by men and women in the Forces stationed in remote districts. At the docks and in devastated areas the electrically-propelled vehicle had rendered invaluable service. All branches were placing first emphasis on work that would hasten the day of victory.

Mrs. Scott, hon. treasurer, presenting the accounts, drew attention to the fact that two-

Mrs. M. B. Jackson, Miss V. Norvick, Miss Caroline Haslett, Lady Swaythling, Mrs. H. Bentham, Mrs. W. Scott and Miss M. Tyacke

thirds of the cost of the film, " Mrs. T. and her Cabbage Patch," was being carried forward and that a sum of £154 had been transferred from the special reserve of the Association before it was incorporated. Nearly 100,000 copies of " Cheerful Rationing " had been sold. There was a balance of £160 cash at bank and in hand.

Election of members of the National Executive Committee was the next business. Mrs. M. B. Jackson, Mrs. F. N. Rendell-Baker and Mrs. W. Scott were re-elected and Mrs. Chas. Deave, Mrs. H. L. Dover, Mrs. F. W. Lawton and Mrs. C. L. Wainwright were elected to fill the places of Councillor Mrs. Garrard, Mrs. F. V. L. Mathias and Mrs. Watson Ingram (who did not wish to stand for re-election) and Lady Snell, who resigned. Lady Snell becomes a vice-president. At a Council meeting later Lady Swaythling was re-elected president, with Mrs. M. B. Jackson as chairman, Mrs. F. N. Rendell-Baker as vice-chairman and Miss F. E. Jones as hon. treasurer.

Some of the delegates to the Conference

A warm tribute to the work done by Mrs. H. Bentham during her three years as chairman was paid by Lady Swaythling, who also spoke of the stimulating and encouraging example given by Miss Haslett, who, she said, typified the spirit of progress and presented a vision of better things to come. Giving some of her impressions of her American visit, Miss Haslett referred to some of the new domestic electrical equipment, washing-up and washing machines, improved cookers, etc., that would be available after the war, when she thought the women of this country and the United States would have to get together to tackle the problem of feeding.

Part-Time Work

Opening a discussion on " Part-Time Work for Housewives," Mrs. M. B. Jackson, vice-chairman, said that she herself, after two years as an ambulance driver, had started work last November in the inspection department of an engineering works. She had found a full day, from 8 a.m. to 5.30 p.m., too much with her household duties to do as well and had since changed over to part-time work, from 8 a.m. to 2 p.m. She thoroughly enjoyed her work and she was sure there was a very large untapped source of woman-power if only women were told of the conditions that prevailed in the factories. Other delegates spoke of their work in nurseries, making life-jackets at home, running British Restaurants, etc. A plea for women to take up positions of responsibility after the war was made by Alderman Mrs. Gregory.

A review of the progress made in connection with the collection of opinions on reconstruction by means of the study sheets was made by Mrs. E. E. Edwards, who said that it was the aim to get a million opinions to form the basis of recommendations to be put forward by the Association. She appealed to more people with specialised knowledge to co-operate. Mr. J. R. Beard said that he was sure that the views of the E.A.W. would be extremely valuable and would be welcomed by the Directorate of Post-war Planning that had recently been set up by the Ministry of Works and Buildings.

An address by the Rt. Hon. R. A. Butler, President of the Board of Education, was given in the evening session. Welcoming him Lady Swaythling said that the E.A.W. had always been interested in education in particular in adult education, and it was essential that education should keep abreast of new developments. Mr. Butler stated that the Government was fully aware of the contribution that the Association had made and welcomed the practical part women were taking in education.

He was convinced that both now and after the war it was necessary to mobilise every person to play his or her part in the days to come. Women had realised this and any observer would agree that the war effort of women would prove conclusive. Our technical colleges were engaged in a very valuable form of training and women were taking part in tens of thousands. Nearly a hundred bursaries there were held by women. The manner in which women could reach high degrees of accuracy in engineering work was remarkable. The contribution of electricity to the domestic sphere had a social as well as a practical importance since it gave the user a chance to develop individuality and improve the home. Some forms of communal enterprise had undoubtedly come to stay and women might well show us the way to provide for individual needs in a collective life.

Steelworks Lighting

Need for Raising Minimum Standards

By M. C. Toner, M.I.E.S.

IN the Factories (Standards of Lighting) Regulations, 1941, statutory force was given for the first time to standards of illumination for various industries. Inspectors of Factories can now discard the ambiguous qualification of " sufficient and suitable " illumination for the more definite one of foot-candle intensity as ascertained by means of a light meter.

The National Industrial Electric Lighting Service was formed to mobilise illuminating engineers to assist industrial firms in securing maximum production. The pooling of the services of these experts all over the country, whereby each inquiry is delegated to a lighting firm on the rota, has tended to avoid duplication of effort and has been largely responsible for the enormous improvement in works lighting during the past two years.

The author contends that in some steelworks the lighting is inferior to what it was in peacetime. He suggests methods of improving the position

In an area extending from Tees-side to the Wash and from the East to the West Coasts, my experience has been that the heavy engineering trades were usually far below the specified standards because in peacetime there was not so large a proportion of working time after dark. The lighting experts of the Ministry of Supply have done valuable work in this connection and I have found executives most appreciative of the technical assistance they have given and of the expedition with which they have acted. They have tactfully convinced managements that the lighting standards required are not only efficient, but economic as regards man-hours and spoilage.

An Unjustifiable Exemption?

A flaw in the new Regulations is the exemption from No. 2 (*a*), which prescribes the values of general illumination 3 ft. above the floor (Schedule, Part 1), of those parts of iron and steel works in which conversion from iron to steel, forging, smelting and rolling are carried out. Standards of illumination there are still very low. Executives have informed me that lighting conditions are worse than in peacetime. Black-out requirements have resulted in the shutting out of daylight from the greater part of the steel plants and rolling mills and in addition shuttering has been erected down the sides, further reducing the daylight component. With this came the use of smaller lamps, often enclosed in crude cylindrical containers, which made conditions worse than ever. One of the largest iron and steel plants in the country was equipped with new lighting where compliance with the Regulations was required, and within a week a deputation of workers at the steel plant and the rolling mills asked for their lighting to be brought up to the same level.

While metal is running at the discharge side it gives a brilliant illumination, but only for a very short period. When the furnaces are alight there is a reasonable illumination opposite the doors. From the charging side I have measured 8 to 12 ft.-candles in a line with the door, but 6 ft. away there has been less than 1 ft.-candle and when one furnace of a group is being relined a large dark patch is left. The illumination during pouring, varying from a brilliant glare to a low intensity only a few strides away, is trying to operatives and may be dangerous.

Trade union officials have informed me that whilst they are receiving a better revenue from members they are paying out more than ever in accident benefit due to broken legs and arms and other more serious injuries, whereas in the past most claims were for burns and less serious injuries. As a result, they said, gangs of men who had worked together for years were broken up and in the time required to train new men to work together output suffered. These officials attributed the increase in serious accidents (300 per cent. since the outbreak of war) to bad lighting due to black-out and long hours.

Minimum standards for lighting in steel plants and iron and steel rolling mills should be raised to the 6-ft.-candle level prescribed in Regulation 2 (*a*). The reduction to 2 ft.-candles permitted where the mounting height of the light sources exceeds 25 ft. tends to defeat the object of the Regulations to increase output. Owing to dust and dirt a 2- to 4-ft.-candle standard soon dwindles to less than 1 ft.-candle. A wise steelworks' manager told me that he specified 6 to 8 ft.-candles for all his plant. This he considered necessary " to have any light left after a week."

Importance of Maintenance

In some cases mercury discharge lamps are preferred by workers, in others sodium and in others again tungsten, without ascertainable reasons. Usually tungsten is chosen because it appears to give a " whiter " light. Special high intensity lighting should be installed at both top and sides to yield 12 ft.-candles over

the area where the rolls are fixed in order to facilitate changing and setting up. The tendency is towards the use of enclosed units with a front of clear or satin glass to assist maintenance.

As men cannot easily be spared for the regular cleaning of fittings, illumination, even in new installations, often drops to low levels. The maintenance programme should be similar to that employed by some of the large stores in peacetime, lamp sections being logged for burning hours and changed at specified intervals by the maintenance staff. Thus, not only are the fittings kept working at their highest efficiency, but the lamps are not allowed to reach an uneconomical level of lighting output. Many large engineering and other industrial firms will find the solution of their lighting problems in the appointment of skilled lighting engineers.

Commissioners' Memoranda

Avoiding Power Conversions : Economy Measures.

IN a recent Press announcement the Board of Trade drew the attention of industrial consumers of fuel to the urgent necessity of avoiding conversion of plant from one fuel to another except on the advice of a Government Department. It was pointed out that such conversions involved a diversion of labour and materials from more vital needs and led to unnecessary fuel supply difficulties. Consumers contemplating the installation of new plant were also asked first to consult the appropriate Department.

In the case of firms executing contracts for one of the Production Ministries it was suggested that that Ministry should be approached. Then, if necessary, the Ministry would consult the appropriate fuel department of the Board of Trade—in the case of electricity the Electricity Commissioners.

Other firms should make an approach to the Board of Trade. In the case of electricity this approach should be through the local electricity supply undertaking. The latter, after any necessary consultation with the Central Electricity Board if substantial new loads are involved, should submit the proposals to the Electricity Commissioners with its observations.

Transformer Operation

While consumers are being urged to economise in fuel it is only just that electricity supply authorities should avoid unnecessary losses and the Commissioners have made some suggestions. They recommend that where two transformers are used in parallel one should be switched out when the load falls below a predetermined level instead of both being left in circuit as in normal circumstances. Where labour conditions permit, the tap switches on transformers supplying low-voltage networks should be operated more frequently. Instead of tap switches being set high enough to give a voltage within the prescribed range of variation under both summer and winter conditions, appropriate settings should be determined for each period and the tap switches set and varied accordingly.

Saving Timber

Electricity supply authorities are urged by the Commissioners to take all possible steps to avoid the excessive use of wood and to conserve existing supplies. They have also arranged for the more expeditious handling of undertakings' requisitions for timber. It is noted that certificates to purchase (from the Timber Control) are now required for all commercial plywood and also salvaged and reconditioned timber. Undertakings should see that all boxes, crates, packing cases and cable drums are quickly returned to manufacturers.

Among the ways in which economy in the use of wood may be secured is the simplification of design, the cutting down of dimensions and wider spacing. Underwood poles and coppice wood, or concrete posts and cleft chestnut poling, can be substituted for square-edged timber in connection with fencing following overhead line work. Moreover, certificates to purchase are not required for these classes of timber. Home-grown hardwood should be used in the place of imported timber. Hardwood poles, 5-7 in. in diameter, are in good supply and should take the place of square timber for all trench strutting.

Standard joinery should be used wherever possible and trimmings and finishings reduced to the minimum, and concrete should be used for flooring. Shuttering timber should be removed from the cement as soon as possible. Pipe and cable trench covers should be of precast concrete or tile wherever possible and stay blocks for overhead lines should also be of concrete unless there are special reasons for the use of wood.

Timber or plywood boards should be dispensed with except in special circumstances and scaffolding should be hired whenever possible.

Miscellaneous

The Commissioners have relaxed the requirement that reinforced concrete slabs shall be used to protect unarmoured mains laid direct in the ground. This is designed to secure further economy in the use of controlled raw materials.

Other matters to which the Commissioners have recently drawn the attention of supply authorities are the Orders relating to the control of rubber tyres, cement sacks, machine tools, scrap metal and tin; standard sizes of bricks; restrictions on display lights; and the salvage of scrap rubber. With regard to the last, the Ministry of Supply (Rubber Control) desires to be notified by electricity undertakings immediately they have scrap cable or wiring for disposal. The undertakings will then be required to sell this scrap in such a manner as will ensure that it ultimately gets into the hands of cable strippers who are now being appointed to deal with all forms of cable with a view to receiving both the rubber and the metal.

COMMERCE and INDUSTRY

Heating Apparatus Restrictions. Citrine Committee's Report

Limitation of Supplies

As reported in the *Electrical Review* of May 15th, the newly-introduced restriction on the supply of space heaters is based on a standard period of six months ended November 30th, 1939. The quota for the June-July period is 8¼ per cent. by value of the goods supplied during this standard period.

With regard to goods already controlled under the Limitation of Supplies (Miscellaneous) Order, 1941, the Board of Trade has decided that in order to save manufacturers and traders the trouble of making new computations, the standard period upon which will be based permitted supplies in the months of June and July of goods in Classes 8, 9, 10, 11, 12, 13, 14, 15 and 17 will be that applicable to the original Order, *viz.*, December 31st, 1939, to May 31st, 1940. Consequently, registered persons will calculate their quotas for the period June 1st to July 31st by reference to the figures which have been returned by them on Form Misc. 13, and these quotas, subject to alterations already advertised, will thus represent one-third of those for the current restriction period of six months ending on May 31st.

The inclusion of space-heating apparatus within the scope of the Limitation of Supplies (Miscellaneous) Order has led to questions as to the classes of goods falling within the definition. Mr. A. Albrecht, the Director of the Electrical Wholesalers' Federation, tells us that after conversations with Board of Trade officials it is understood that the term "space-heating apparatus" covers radiators and fires (all types); convectors; panel heaters; and air conditioners which incorporate heating elements. At present tubular heating equipment is considered to have an industrial application and is not included.

As to dual-purpose apparatus, if an appliance is primarily designed for space-heating but can also be used for cooking it comes within the control. A hot-plate which may be used for heating purposes as well is not controlled. So far no definite rulings have been made in the cases of car heaters (under-bonnet type), drying cabinets, towel rails and bed warmers other than pads or blankets which are already restricted.

Organisation of War Industry

Proposals have been made by the Committee on Regional Boards, presided over by Sir Walter Citrine, for the improvement of the regional organisation of the Production and Supply Departments. The Committee recommends that in each region there should be an experienced Regional Director of Production representing the Minister of Production who would have with him the regional controllers of the Supply Departments (including the Machine Tool Control) and co-ordinate their activities. He would have the power to decide questions relating to the allocation of machine tools, premises, raw materials and labour; as regards the last he would act in co-operation with the regional controller of the Ministry of Labour and National Service.

The Regional Director of Production would act as chairman of his Regional Board which would comprise representatives of the Admiralty, Ministry of Supply, Ministry of Aircraft Production, Board of Trade, Ministry of Labour and of employers and workpeople. Each board would sub-divide its region into districts with representative production committees, this scheme being applied in the first place to the engineering and allied industries.

The establishment of a Central Co-ordinating Committee and a National Production Advisory Council is also recommended by the Committee, whose report is obtainable from the Stationery Office (Cmd. 6360, price 6d.).

In a memorandum the Minister of Production (Mr. O. Lyttelton) states that the Government accepts the recommendations generally, but it is not considered practicable to merge the Machine Tool Control in the regional organisation, although the staff of the Control will be available to the Regional Boards for consultation.

Hours of Work

It was announced by the Ministry of Labour and National Service last week that in considering the labour force required by any industry or undertaking Man-Power Boards would have regard to the hours worked. Where these were less than 52 hours a week exclusive of meal breaks in the case of industrial work or 46 hours in the case of office staffs it would be assumed that a reduction of staff could be achieved by increasing the hours of the men and women retained except in special circumstances.

The same principle would be applied in cases where it was found that staff were still taking more than two weeks' holiday in the course of a year.

Women's Post-war Planning

The Electrical Association for Women is one of the organisations co-operating in a Women's Exhibition on Housing and Planning, arranged by the Housing Centre, which opens to-day, Friday, at the Royal Institute of British Architects, 66, Portland Place, London, W.1, and continues until next Friday. In connection with the exhibition a one-day conference was held yesterday, in which over a dozen women's organisations took part.

Sales Representatives after the War

An address on this subject was given by Mr. T. H. Windibank, A.M.I.E.E., at a recent meeting of the Electrical Trades Commercial Travellers' Association. He thought that the lessons of wartime economics and production should lead to a greater and more efficient distribution of commodities, raising the general standard of living.

With controlled distribution the commercial traveller would get rid of some of the undesirable elements of competitive salesmanship, but he would be required to have a better understanding of his calling. It should not be possible

after the war for mushroom trading concerns to exploit men with war gratuities; the Government should recognise the calling and protect it from the abuses which followed the last war.

He suggested that the Association should co-operate in the training of representatives and he outlined a programme of lectures which would impart a sound knowledge of the essentials of electrical salesmanship.

Intensive Training Schemes

The Borough Polytechnic claims to have been the first to institute an intensive course in electrical engineering under the Hankey scheme —a course which Mr. W. C. S. Phillips, B.Sc., M.I.E.E., Head of the Department of Electrical Engineering and Physics, assures us is proving very successful. Another course is commencing on June 22nd and those interested should get into touch with the Borough Polytechnic, S.E.1.

Disposal of Old Documents

Attention has already been directed to the fallacy of keeping bank vouchers as these carry very little weight as evidence in courts. With regard to other documents and books, many firms believe that they must retain these for six years, although one large undertaking which decided to dispose of all documents over two years old has never had reason to consult any papers so disposed of. As a guide to firms a leaflet compiled by two leading chartered accountants has been published by the Waste Paper Recovery Association, 154, Fleet Street, E.C.4. It gives a list of suggested periods during which different types of documents should be kept.

Certificates for Rubber Gloves

Rubber gloves have hitherto been available for purchase not only by doctors, electricians and others who need them for essential purposes, but also by the general public. Henceforward the sale of rubber gloves for other than absolutely essential use is prohibited. Under the Rubber Gloves Order (S.R.& O.1942 No. 918) (Stationery Office, 1d.) gloves made wholly or partly of rubber may not be supplied except against a certificate signed by certain specified persons. Industrial concerns covered by the Factories Act, 1937, may apply forthwith for certificates to Inspectors of Factories. Certificates will be given only where the industrial need is considered essential and no substitute is available.

Electric Iron Fatalities

Giving evidence at an inquest at Bexhill recently the borough electrical engineer (Mr. R. C. Carter) stated that the electric iron concerned was bought at a chain store and was defective. The victim was a Canadian soldier, Gunner H. W. MacKenzie, who received a fatal shock when trying to remove the connecting wire from the iron after pressing his trousers. A verdict of " Accidental death " was returned.

A fault in an electric iron also caused the death of Albert Edward Price (30), of Winson Green. At the inquest last week at Birmingham it was stated that in order to hear the wireless he fitted his wife's electric iron to the light instead of connecting it, as usual, to the wireless socket, and received a fatal shock. Mr. F. Whip, an electrical engineer, stated that the iron had an internal fault. The stone floor of the scullery had been instrumental in causing the shock. On behalf of the makers of the iron the managing director stated that the faulty element had not been fitted by them; he was of the opinion that the iron had been repaired elsewhere. In returning a verdict of "Accidental death," the coroner said that electric irons should not be plugged into a light socket unless the user was standing on a dry wooden floor covered with a rug.

Electrical Appliance Guarantees

Manufacturers of domestic electrical appliances who are members of B.E.A.M.A. announce that from June 1st until further notice the standard guarantee on all such appliances sold on or after that date (excluding domestic electric cookers for which the standard guarantee already announced remains unchanged) will be limited by one or other of the following conditions : (*a*) Twelve months maximum from the date of purchase by the original user only or (*b*) at the manufacturers' option a maximum of thirteen months from the date of dispatch from their works, thus allowing a month's stocking period. In both cases this is subject to the original user retaining the goods in his possession until the guarantee period has expired.

Luxury Wireless Sets

On May 20th, Mr. J. Griffiths asked the President of the Board of Trade whether he was aware that Harrods, Ltd., London, S.W.1, were advertising new model luxury wireless sets at prices of 32 guineas and 59 guineas, and whether it was the policy of his Department to permit the production of such sets and the employment of valuable materials and labour thereon.

Captain Waterhouse, who replied, said that the attention of the Board of Trade had been drawn to this case. It was not their policy to permit the production of model luxury sets. The prices at which these sets were offered for sale were being investigated by the Central Price Regulation Committee. In the meantime, Harrods had withdrawn the sets from sale.

Display Lighting Restrictions

The Advertisement Lighting (Restriction) Order, 1942, which came into force recently, does not apply to the use of fittings and appliances which are reasonably necessary for serving the public or to such a display of light as is described in Part IV of the Lighting Restrictions Order, 1940.

The Board of Trade now points out that Article 41 of Part IV of the Lighting (Restrictions) Order, 1940, was repealed by the Lighting (Restrictions) (Amendment) Order, 1941. In consequence, the exception provided for in Article 1 (ii) of the Advertisement Lighting (Restriction) Order, 1942, does not cover such display of light in shops for purposes of advertisement as is described in Article 41.

Control of Second-hand Goods

It was announced in the House of Commons on May 7th that new Orders were to come into force controlling the price of second-hand goods, and of goods sold by auction.

The Second-Hand Goods Order (S.R. & O. 1942, No. 815) provides that the maximum

price of any second-hand goods to which the Order applies (i.e. price-controlled goods under the Goods and Services (Price Control) Acts), shall be the price at which the same or similar goods are being lawfully sold or offered for sale new by a comparable business at the date of the sale of the goods or within six months prior thereto. In cases where there is no comparable business since the commencement of the war, the maximum price shall be the estimated price at which it would have been reasonable for such goods when new to be sold in the course of a similar business during the six months prior to September 3rd, 1939.

The Sales by Auction Order (S.R. & O. 1942, No. 816) prohibits from May 26th the sale by auction, except under licence of the Board of Trade, of any goods which are price-controlled under the Goods & Services (Price Control) Acts, and any goods the production, storage, distribution or prices of which are regulated or controlled by Orders made under the Defence Regulations.

There are two forms of licences, one, a general licence covering second-hand clothes, unredeemed pledges on behalf of a pawnbroker, and the sale of private goods and property which do not form part of the stock or assets of any business. The other is a special licence for other goods which will be granted at the discretion of the local Price Regulation Committee.

Trade Announcement

The London office of the Sturtevant Engineering Co., Ltd., has been removed to Victoria Station House, 189, Victoria Street, London, S.W.1 (telephone: Victoria 9201/3).

Large Swedish Transformer

WHAT is claimed to be the largest transformer in the world has recently been built by the A.S.E.A. Co. for the Swedish Government transmission system between the hydro-electric plant in the north and the industrial centres of the south. It is a 120,000-kVA, 205/132-kV, three-phase unit with a tertiary winding rated at 40,000 kVA at 9·8 kV, which feeds a regulator capable of raising or lowering the secondary voltage by 19·8 kV above or below 132 kV in steps of 1·67 per cent.

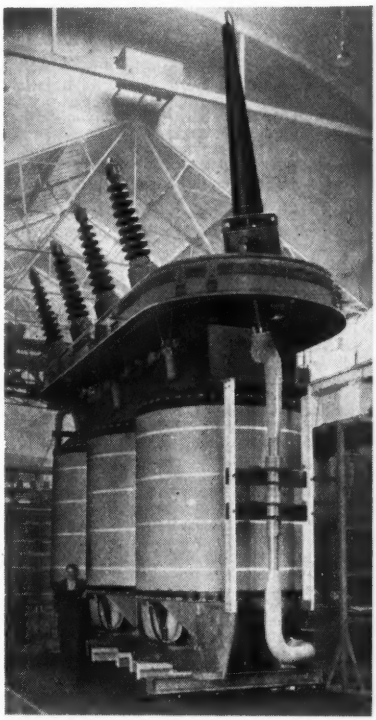
In order to minimise the amount of material and oil used, the tank is in three rounded but connected sections which follow the contour of the windings. Heat is dissipated by gilled tubes set radially round the whole tank. At full load in warm weather forced cooling is given by eight built-in propeller fans, half of which come into service automatically on the winding temperature reaching 158 deg. F., the second group being started at 176 deg.

Protective arrangements include a Buchholz relay, magnetic high and low oil-level signals, top-oil temperature alarm, three resistance elements for indicating maximum winding temperatures, and three-ratio current transformers round the 205- and 132-kV neutral-point terminals for relay protection. Full-load efficiency of the unit measured 99.4 per cent., no-load losses 262 kW, and magnetising current 1·22 per cent. Overall length and breadth over the cooling tubes are 37 ft. and 19 ft. 10 in., and the greatest height from plinth to top terminals 26 ft. 10 in.

The weight of the complete transformer without oil is stated to be 219 tons (with oil 298 tons). After the removal of accessories necessitated by loading-gauge restrictions and fitting a temporary thin cover to the tank (which was filled with dry air) the weight for transport was 162 tons. Including the weight of the ten-axle truck, the total figure became 215 tons, the heaviest ever taken on the Swedish railways. The train was run only at night and at a speed of three to six miles an hour and took 5½ days on the journey.

Compared with two transformers of the same aggregate output there was a saving of 17 tons of copper, 87 tons of oil, and 109 tons of iron and other materials as well as a reduction of full-load losses by 240 kW.

A.S.E.A. Electric, Ltd., is associated in this country with the Fuller Electrical & Manufacturing Co., Ltd., at whose works 132-kV transformers of up to 73,000-kVA output have been built.



120,000-kVA, 205/132-kV, 3-phase transformer built for the Swedish Government

South Shields Judgment

Application of Undertakings' Profits

ON May 21st the Court of Appeal consisting of the Master of the Rolls, Lord Justice du Parcq and Mr. Justice Lewis heard an appeal by the South Shields Corporation against a decision by Mr. Justice Lawrence on a case stated by the Special Commissioners of Income Tax. *The Times* states that the case rose out of the assessment of the Corporation's tax liability for the year 1935-36. In this period it paid interest on borrowed money amounting to £132,396 (deducting income tax) and against this there were "profits or gains" totalling £91,504 and it was agreed that the Corporation was liable to tax on the difference—£40,892. The profits or gains included the surpluses of the electricity undertaking (£31,859) and the transport undertaking (£7,778). After payment of interest on the amounts borrowed specially for these undertakings the net profits were £12,628 and £2,589 respectively.

Separate accounts were kept for these undertakings, but the receipts and payments were paid into, and out of, the general rate fund. Section 114 of the Corporation's Act of 1935 provided that if the receipts from an undertaking exceeded the expenditure for certain defined purposes of the undertaking the Corporation might apply out of the general rate fund a sum not exceeding the amount of this excess for specified further purposes of the undertaking. The application of the surplus revenue from the electricity undertaking was dealt with by Section 115.

The Corporation maintained that the general rate fund consisted partly of taxed and partly of untaxed receipts; the £91,504 was in the former class. Interest to the extent of £132,396 was payable out of the general rate fund and it was lawful to pay the interest to the extent of £91,504 out of the profits of that amount already charged to tax and the Corporation was assessable to tax for 1935-36 only on the difference between the two amounts—£40,892.

Case for the Crown

The Crown contended that the interest could not be paid out of the taxed profits which were dedicated by statute to other purposes than the payment of interest; that the profits of the two undertakings concerned were allocated by statute in a set manner and were not wholly available for interest or for rate relief; and that the Corporation was accordingly liable to tax on £56,109, the difference between the £132,396 paid in interest under deduction of tax and £76,287 taxed income remaining after the statutory charges payable out of the taxed income had been met, i.e., the sum of £91,514 less £15,217 which was not available for the payment of interest.

The Special Commissioners held that the general rate fund was a "mixed" fund and in making payments from it the Corporation had paid primarily out of taxed income. Applications of money from the rate fund under Sections 114 and 115 of the Act did not have to be made from any particular part of the fund. The form of accounts of the two undertakings concerned did not afford evidence that the actual surplus income had been used or set aside for a specific purpose. The Commissioners therefore ruled that the Corporation possessed in the general rate fund a taxed amount of £91,504 which it could legally use for paying the interest in question and it must be deemed to have paid that interest primarily out of the taxed income.

Upon the appeal of the Crown Mr. Justice Lawrence reversed this decision, holding that the Corporation could not devote the profits derived from any of its undertakings to the payment of interest on money borrowed from another undertaking or for general purposes.

The Court of Appeal now decided in favour of the Corporation and the Special Commissioners on the ground that previous restrictions upon the right of the Corporation to apply the profits of one undertaking to the payment of interest in connection with another undertaking, or for general purposes, had been abolished by its 1935 Act. Therefore it was entitled to treat the whole of its taxed profits as a fund from which interest on moneys borrowed for any purpose could be paid and to deduct and retain tax in respect of this interest to an amount equivalent to the taxed profits.

Leave was given to the respondents to appeal to the House of Lords.

French Electrical News

(From a Correspondent)

THE *Revue des Deux Mondes*, which is published in unoccupied France, recently devoted an article to the electricity position of France. To illustrate the effect of weather conditions it is recalled that while in 1938 non-industrial consumption was 20 per cent. of total, in 1939 France consumed 17,550 million kWh of which only 11 per cent. was used for light, heat and commerce, the rest going to industry. In 1941 inclement weather caused a steep rise in electricity consumption and in the first fortnight of November an additional 2 million kWh was used for heating alone owing to the intense cold.

Before the war steam stations were used to compensate for falls in hydro-electric production due to drought, but this could no longer be done owing to the coal shortage. At the moment thermal plant produced 43 per cent. of the total output, and water-power 57 per cent., and the margin would tend to grow as coal and transport became more difficult.

It now appeared that the melting of the snows on the mountains, with a consequent increase in water-power, would allow a few more stations on the "Metro" to be opened. Recently the Champs Elysees and Rue du Bac stations were opened and lifts and moving stairways in some stations were again moving. To alleviate the transport shortage seats were being taken out of the trains so as to provide more standing room. As there were no buses the "Metro" was vitally important.

ELECTRICITY SUPPLY

Utilities and Planning. Joint Meter Reading

Barrow-in-Furness.—MAINS AND SERVICES.—Sanction has been obtained by the Electricity Committee to borrow £3,000 for mains and services. Mains are to be extended at a cost of £220 to provide supply to Roanhead Farm and feeders are to be laid and four 500-kVA transformers provided in the Walney district at a cost of £3,200.

REPLACEMENT OF DAMAGED APPARATUS—Application is being made for permission to borrow £1,450 for the replacement of damaged domestic appliances.

Cheshire.—REPRESENTATION ON PLANNING COMMITTEES.—A resolution of the North Wales and South Cheshire Joint Electricity Authority suggesting the advisability of representatives of electricity undertakings being appointed to serve on County Planning Committees was recently received by the Cheshire Roads and Bridges Committee and referred for the consideration of the several Town Planning Committees in the county, with an intimation that the County Council approved of it, and was of opinion that representatives of gas and water undertakings should also be included on them.

Chesterfield.—BULK SUPPLY CHARGES.—The Electricity Committee is to ascertain from the Derbyshire and Nottinghamshire Electric Power Co. whether it is willing to increase the maximum demand limit under the bulk supply agreement to a higher figure provided the Corporation increases the minimum payment.

NO RATE CONTRIBUTION.—No contribution is to be made by the Electricity Committee to the relief of rates for 1942-43.

Hawick.—OPTION TO PURCHASE UNDERTAKING.—It was reported at the last meeting of the Town Council that the Electricity Commissioners had made an Order extending the period within which the option to purchase the undertaking, in the Council's area, of the Urban Electric Supply Co., Ltd., might be exercised until January, 1944.

Inverness.—BULK SUPPLY FAILURES.—At a recent meeting of the Electricity Committee letters were submitted from the Electricity Commissioners explaining the cause of the failures in the partial bulk supply on various occasions. Mr. G. C. McLean, engineer and manager of the Corporation undertaking, stated that a representative from the manufacturers was to call on him shortly in connection with the switchgear. The Committee agreed to recommend that if a satisfactory arrangement could not be come to between the company's representative and the electrical engineer with regard to the fitting of time-lags, that the provost, electrical engineer and town clerk be empowered to request the Electricity Commission to send their Engineering Inspector to Inverness as suggested by them.

London.—AUTOMATIC SOOT BLOWING PLANT.—At last week's meeting of Fulham Borough Council the Electricity and Lighting Committee reported that experiments had been proceeding in connection with the installation of automatic soot blowing plant on the boilers. These experiments, in a simple form, had proved successful, and the electrical engineer had suggested that plant manufactured by Hopkinsons, Ltd., should be installed, on two boilers, and that the Stirling Boiler Co., Ltd., should be allowed to install plant of their own design on their boilers. A comparison could then be made of the two systems in order to ascertain which was more suitable for standardisation. The Stirling Boiler Co. had offered to install the plant on its own responsibility, leaving the question of payment, if any, to be settled when the plant had been thoroughly tested. It would, however, be necessary to place a contract with Hopkinsons, and the cost would amount to approximately £6,700. The Central Electricity Board had agreed to the proposals and to the expenditure of this amount, but it would be necessary to obtain the sanction of the Commissioners.

HACKNEY FINANCES.—In accordance with the Council's policy it is proposed to charge the deficit on the working of the electricity undertaking for the past year to the electricity reserve fund, which stands at £166,000. To meet the deficit and provide a small working balance loans totalling £44,573 are to be transferred so as to become investments of the superannuation fund.

Middlesbrough.—METER READINGS IN OUTLYING AREAS.—The Corporation has considered a joint meter-reading plan for outlying areas where there are both gas and electricity consumers. It has been decided not to make any alterations to the present system, but in the event of additional meter readers being needed, it is proposed to give the joint meter-reading plan a trial.

Pudsey.—TRANSMISSION COSTS.—A question was asked at a recent meeting of the Council regarding the employment of a firm of consulting engineers to act for the Council and other local authorities in investigating a report on the cost of electricity purchased from the Yorkshire Electric Power Co. Councillor S. Wilcock, chairman of the Electricity Committee, replying, said that in the 1912 Electricity Act there was a clause which stipulated that the supplying authority should within a certain period declare its transmission costs. Such a declaration by the Yorkshire Electric Power Co. was now several years overdue, and despite continued approaches by Pudsey and other local authorities it had so far not been forthcoming.

Stockton-on-Tees.—SCHEME FOR JOINT METER READINGS.—The Town Council has approved in principle proposals for the joint reading of gas and electricity meters to save manpower. Details are to be worked out by the appropriate officials. There are stated to be about 20,000 electricity meters and 18,500 gas meters in the town, while in the outlying areas there are 13,000 gas meters, but the electricity is supplied by the North-Eastern Electric Supply Co., Ltd. A disparity in holidays, sickness allowances and wages exists between the Gas and Electricity Departments, and these, it is stated, would need to be adjusted before a joint scheme could be operated.

FINANCIAL SECTION

Company News. Stock Exchange Activities.

Reports and Dividends

Allen West & Co., Ltd., report a trading profit for the year to January 31st of £124,270, as compared with £113,180 for the previous year, plus dividends received of £5,757. After deducting debenture interest, directors' fees, depreciation reserve, etc., it is proposed to pay a dividend of 7½ per cent. (same) and to carry forward £69,526 (against £55,894 brought in).

The British Thermostat Co., Ltd., in its report for the year ended January 31st shows a net trading profit of £45,221, as compared with £67,019, plus sundries, £3,903, and a net balance of £29,846 (against £34,595). As already announced, the dividend for the year is maintained at 18½ per cent. by the final payment of 11 per cent. and £13,778 is carried forward (against £16,682 brought in).

Glenfield & Kennedy, Ltd., report a net profit for the year ended March 31st of £68,616, as compared with £67,537 for the preceding year. It is proposed to pay a final ordinary dividend of 5 per cent., again making 10 per cent. for the year, and to repeat the bonus of 10 per cent. The balance carried forward is £37,026 (against £37,606 brought in).

Thomas De La Rue & Co., Ltd., report a profit for the accounting period of twenty-one months to December 27th, 1941, of £187,214. In view of the current financial position, necessitating bank overdraft, the directors are unable to recommend the payment of a dividend. For the year to March 31st, 1940, a dividend of 15 per cent. and a bonus of 6 per cent. were paid. The profit was £103,446.

The River Plate and Other Securities Corporation, Ltd., reports an income for the year to April 15th of £61,718, as compared with £59,686 for the preceding year, and a net revenue of £26,622 (against £29,996). The total ordinary dividend for the year is 7 per cent. (against 7½ per cent.), and £14,933 is carried forward (against £13,763 brought in).

The West London & Provincial Electric & General Trust reports a net profit for the year ended March 31st of £10,261, as compared with £11,315 for 1940–41. The final ordinary dividend is 3½ per cent., making 5½ per cent. for the year (same) and £3,918 is carried forward (against £3,902 brought in).

The St. Austell & District Electric Lighting & Power Co., Ltd., has announced a final dividend of 6 per cent., maintaining the distribution for the year at 10 per cent., less tax.

The Palestine Electric Corporation, Ltd., is paying the half-yearly dividends on the 4½ per cent. redeemable cumulative and second redeemable cumulative preference shares.

Vactric, Ltd., is paying a further two years' dividend on the 6 per cent. cumulative preference shares, thus clearing off the balance of arrears and bringing the payment up to date.

Enfield Rolling Mills, Ltd., again announce an ordinary dividend of 2½ per cent. for the year.

The Brush Electrical Engineering Co., Ltd., is holding an extraordinary general meeting on June 2nd to consider a resolution that the capital be increased to £1,500,000 by the creation of 500,000 £1 shares in connection with the plan to convert the company's debenture debt to share capital.

New Companies

T. I. (Group Services), Ltd.—Private company. Registered May 15th. Capital, £1,000. Objects: To provide and render such services as may be required by Tube Investments, Ltd., or any subsidiary company; to act as buyers, sellers or buying and selling agents for such companies; to carry on the business of manufacturers and repairers of electrical plant, tubes, etc. The subscribers are: H. C. Chambers, 194, Rugby Road, Leamington Spa, and A. J. Corbett, 25, Oakfield Road, Selly Park, Birmingham, 29. Solicitors: Pinsent & Co., Birmingham.

Highlife Products, Ltd.—Private company. Registered May 8th. Capital, £500. Objects: To carry on the business of engineers, electricians, manufacturers and repairers of and dealers in electrical goods, wireless sets, etc. M. McKay, 30, Lushington Road, Catford, S.E.6, is the first director.

South Wales Power Station Co., Ltd.—Public company. Registered May 12th. Capital £100. Objects: To carry on the business of generating and supplying electricity, etc. Directors: E. C. Mekie, 4, Martin's Avenue, Epsom, Surrey; and A. M. Scott, 67, Highlands Heath, S.W.15. Secretary: E. C. Mekie. Registered office: 30, Gillingham Street, S.W.1.

Companies' Returns

Statements of Capital

Wireohms, Ltd.—Capital, £6,400 in 4,000 preference and 2,400 ordinary shares of £1. Return dated November 19th (filed December 18th). 1,755 preference and 2,395 ordinary shares taken up. £4,150 paid. Mortgages and charges: Nil.

Radenite Batteries, Ltd.—Capital, £20,000 in £1 shares. Return dated December 17th. 16,885 shares taken up. £4,654 paid. £12,231 considered as paid. Mortgages and charges: Nil.

E.M.I. Service, Ltd.—Capital, £100 in £1 shares Return dated January 2nd. All shares taken up. £100 paid. Mortgages and charges: Nil.

Wall & Attwooll, Ltd.—Capital, £5,000 in 5,000 ordinary shares of £1 each. Return dated January 12th. All shares taken up. £5,000 paid. Mortgages and charges: Nil.

British Electric Transformer Co., Ltd.—Capital, £1,000,000 in 190,625 preference and 375,000 ordinary shares of £1 each and 1,737,500 ordinary shares of 5s. each. Return dated January 2nd. 190,625 preference and 400,000

ordinary shares taken up. £266,518 12s. 6d. paid. £24,106 7s. 6d. considered as paid. Mortgages and charges: Nil.

Magna Wire & Cable Co., Ltd.—Capital, £11,000 in 10,000 preference shares of £1 each and 20,000 ordinary shares of 1s. each. Return dated December 15th. 2,027 preference and 11,600 ordinary shares taken up. £2,027 paid. £580 considered as paid. Mortgages and charges: Nil.

William Smith (Birstall), Ltd.—Capital, £1,000 in 1,000 shares of £1 each. Return dated January 14th, 1942. All shares taken up. £200 paid. £800 considered as paid. Mortgages and charges: Nil.

Consolidated Electrical Supplies, Ltd.—Capital, £100,000 in 100,000 shares of £1 each. Return dated December 31st, 1941 (filed February 11th, 1942). 3 shares taken up. £3 paid. Mortgages and charges: Nil.

R. Pain & Sons, Ltd.—Capital, £6,000 in 6,000 shares of £1 each. Return dated November 30th, 1940 (filed January 29th, 1942). 5,304 shares taken up. £1,904 paid. £3,400 considered as paid. Mortgages and charges: Nil.

C. T. Briscoe & Son, Ltd.—Capital, £5,000 in £1 shares. Return dated July 14th, 1941 (filed February 25th, 1942). 2,750 shares taken up. £860 paid. £1,890 considered as paid. Mortgages and charges: £1,000.

G. & L. Electrical Supply Co., Ltd.—Capital, £1,000 in 1,000 shares of £1 each. Return dated December 31st, 1941 (filed March 5th, 1942). All shares taken up. £2 paid. £998 considered as paid. Mortgages and charges: £2,000.

Brookhirst Switchgear, Ltd.—Capital, £550,000 in 550,000 shares of £1 each. Return dated November 26th, 1941 (filed December 8th, 1941). 126,002 shares taken up. £30,502 paid. £95,500 considered as paid. Mortgages and charges: Nil.

East India Tramways Co., Ltd.—Capital, £135,000 in 135,000 ordinary shares of £1 each. Return dated January 13th. 133,334 ordinary shares taken up. £133,334 paid. Mortgages and charges: Nil.

Dynamo Lighting & Ignition, Ltd.—Capital, £250 in 1s. shares. Return dated January 14th. 2,000 shares taken up. £100 paid. Mortgages and charges: Nil.

T. C. Gilbert & Co., Ltd.—Capital, £5,000 in £1 shares. Return dated January 13th. 3,200 shares taken up. £2,300 paid. £900 considered as paid. Mortgages and charges: Nil.

Peterborough General Electric Co., Ltd.—Capital, £500 in 500 shares of £1 each. Return dated December 15th, 1941. All shares taken up. £500 paid. Mortgages and charges: Nil.

Mortgages and Charges

North-Eastern Electric Supply Co., Ltd.—Particulars filed of debenture stock to secure £2,202,039 and a premium of 2% in certain events authorised January 28th, 1942, and covered by trust deed, dated April 22nd, 1942. The stock constitutes a charge on the company's undertaking and property, present and future, including uncalled capital and electric lighting and power undertakings. The whole amount is now issued. Trustees: Law Debenture Corportation, Ltd.

Southern Electric Equipment Co. (Hove), Ltd.—Mortgage and debenture, charged on 66, Blatchington Road, Hove, and the company's undertaking and other property, present and future, including uncalled capital, dated April 30th, to secure all moneys due or to become due from the company to District Bank, Ltd.

Peto Scott Electrical Instrument (Holdings), Ltd.—Mortgage on proceeds of a certain contract, dated May 5th, to secure all moneys due or to become due from the company to Midland Bank, Ltd.

Underwood (Electric), Ltd.—Assignment of contract moneys, dated April 30th, to secure all moneys due or to become due from the company to Martins Bank, Ltd., not exceeding £1,600.

F. H. Hellyar, Ltd.—Assignment on April 30th, of certain contract moneys, to secure all moneys due or to become due from the company to Barclay's Bank, Ltd.

Woking Electric Supply Co., Ltd.—Issue on April 22nd, of £4,842 debentures, part of a series already registered.

Receivers Released

Orel Micro Electric, Ltd.—S. B. Green, of 29, Great Pulteney Street, W.1, ceased to act as a receiver and/or manager on May 8th.

Silvagrey Electric, Ltd.—R. W. Cox, of 12, Low Pavement, Nottingham, ceased to act as receiver on May 9th.

Bankruptcies

B. J. Wainwright, electrician, 2, Hillcrest Gardens, Dollis Hill Lane, Cricklewood, N.W.2, lately carrying on business as the Wells Road Garage, 197-202, Wells Road, Shepherd's Bush, W.12, and as Wainwright Neon Displays at 197, Wells Road, Shepherd's Bush, previously at Harlesden, N.W.10.—Receiving order made May 5th on debtor's own petition. First meeting May 27th and public examination June 9th, both at Bankruptcy Buildings, Carey Street, London, W.C.2.

S. W. Godfrey, now residing at 44, Cromwell Road, Sprowston, and formerly residing at 141, Mansfield Road, Nottingham, and carrying on business at that address and 289, Alfred Street Central, Nottingham, as electrical and radio engineer.—Application for discharge to be heard on June 19th at the County Court House, St. Peter's Gate, Nottingham.

G. A. Weston, electrical contractor and engineer, 5-6, Roman Wall House, Crutched Friars, London, E.C.3.—Last day for receiving proofs for dividend June 3rd. Trustee, Mr. L. A. West, Bankruptcy Buildings, Carey Street, London, W.C.2, Senior Official Receiver.

S. V. Knight, electrical engineer, 10A, Watford Way, Hendon, London.—Trustee, Mr. N. W. Osborne, 11-12, Finsbury Square, London, E.C.2, released April 24th.

A. E. Baker, electrical engineer, 42, Chapel Road, Bexley Heath, Kent.—Discharged as from May 15th, 1942.

STOCKS AND SHARES

TUESDAY EVENING.

THE Treasury has announced its intention to impose a further check upon dealings in stocks and shares of new issues of companies whose securities are being introduced to the public through the Stock Exchange markets.

The Treasury disclaims any intention of placing restrictions upon the provision of capital in such cases as those where money is required for the national effort. The net effect will be, however, to narrow still further the investor's opportunity for acquiring stock or shares in any but those of existing companies. The Order has made no particular difference to Stock Exchange prices, but its oblique influence will be directed towards adding one more to the various factors which consistently make for higher prices of the stocks and shares that are now negotiable.

Where the Profits Go

Expansion of output; increased earnings; greater turnover; these are factors which seem nowadays to go for little in determining the amount of distributable earnings by industrial companies such, for example, as those concerned with electrical and allied industries. Additional profits are monopolised by taxation; expansion of business and rising production are neutralised by advances in cost, and difficulties of obtaining materials. Nevertheless, in spite of these handicaps, industry continues to make a remarkably good showing, and the profit and loss accounts of most companies are satisfactory enough to holders of the companies' shares. The advantage of having a favourable E.P.T. standard becomes more and more pronounced with every week that passes.

Some companies succeed in paying off arrears of dividends which have accumulated on their pre-ordinary capital. Vactric, Ltd., the manufacturers of electric vacuum cleaners, have announced a payment of two years' preference dividend, thus writing off the arrears, and bringing the dividend distribution up to date. The ordinary shares, therefore, come within sight of a dividend and, on the strength of this, the price has come up, as indicated in our lists, from 3s. 6d. at the beginning of this year to the present price of 6s. The shares are of 5s. denomination and the last-paid dividend was in respect of 1937/8, when they received 4 per cent.

Price Fluctuations

General Electrics are a good market at 83s. 9d., many thousands having been bought lately at and around 84s. Last year the company announced its dividend—which is paid once a year—on July 18th. Anticipation looks for the previous 18½ per cent. to be repeated. Brush ordinary shares have hardened to 5s. 6d., on account of the interest aroused in the company by the rearrangement of its capital; and, of course, by the recent declaration of a 6 per cent. dividend after twelve years absence from the dividend list. English Electrics have further risen to 42s. and Ever Readys to 32s. The satisfactory return on the money offered by Hopkinsons has drawn buyers into the market, and the price is better at 48s. 9d. Electric and Musical Industries at 15s. show a gain of 9d. The activity in Cable and Wireless stocks has slackened off to some extent, and the ordinary at 58 shows no change on the week. The preference has hardened to 98. Mexican Light & Power first bonds at 82½ are a point up; the seconds, at 60, have risen 15 points in half as many weeks. The recent rise in Anglo-Portuguese Telephones brought in a few sellers, and at 13s. 9d. the price shows 1/16 reaction. Victoria Falls preference are better at 35s.

London Passenger Transport prior-charge stocks have gone back to a trifling extent, and Southern 5 per cent. preference is also a point lower. British Electric Traction deferred at 925 has recovered the £15 dividend deduction.

Shares on Offer

During the past few business days, 500 Bournemouth & Poole Electric ordinary came in for sale at 54s. The company paid 12½ per cent. in each of the last two years, against an annual 15 per cent. in the two preceding years. At the price mentioned, the yield on the money is £4 12s. 6d. per cent. Richmond Electric ordinary, connected with the same group of County of London subsidiaries, can be obtained at 26s. 3d. It is not often that there are Richmonds in the field. A small line of Scottish Electric Power ordinary shares has been on offer at 40s., giving at that price 4 per cent., on the 8 per cent. dividend which has been distributed annually for some time past. Midland Counties Electric ordinary are available at the same figure, and Midland Electric Corporation for Power Distribution can be bought, as to 3,000 shares, at 42s., returning £4 5s. 9d. per cent. The Midland Counties has paid 8 per cent. and the Midland Electric Corporation 9 per cent. per annum for some time past. In the Home group the highest yielding shares under present conditions are South Londons, which pay £5 7s. 8d. and Newcastle Electric ordinary, which at 27s. 6d. return £5 1s. 10d.

Two Companies' Reports

Allen West, Ltd., have done well for the year which ended on January 31st last, the trading profit of £124,000 being £11,000 up. The dividend, as already announced, is repeated at 7½ per cent. The carry-forward

(*Continued on page* 710)

ELECTRICAL INVESTMENTS

Prices, Dividends and Yields

Company	Dividend 1939–40	Dividend 1940–41	Middle Price May 26	Rise or Fall	Yield £ s. d.
Home Electricity Companies					
Bournemouth and Poole	12½	12½	53/9	−⅛	4 13 0
British Power and Light	6	6	28/6	..	4 4 3
City of London	7	7	27/6	..	5 1 9
Clyde Valley	8	8	40/–	..	4 0 0
County of London	8	8	37/6	..	4 5 6
Edmundson's:					
7% Pref.	7	7	35/–	..	4 0 0
Ord.	6	6	28/6	..	4 4 3
Elec. Dis. Yorkshire	9	9	42/–	..	4 5 9
Elec. Fin. and Securities	12½	12½	48/9	..	5 2 6
Elec. Supply Corporation	10	10	45/–	..	4 9 0
Isle of Thanet	2	Nil	11/3	..	—
Lancs. Light and Power	7½	7½	35/–	..	4 5 9
Llanelly Elec.	5½	5½	22/6	..	4 17 9
Lond. Assoc. Electric	4½	4	18/9	..	4 5 10
London Electric	6	6	25/–	..	4 16 0
London Power Red. Deb.	5	5	104½	..	4 15 7
Metropolitan E.S.	8	8	36/3	..	4 8 6
Midland Counties	8	8	39/6	..	4 1 0
Mid. Elec. Power	9	9	42/–	..	4 5 9
Newcastle Elec.	7	7	27/6	..	5 1 10
North Eastern Elec. Ordinary	7	7	31/3	..	4 9 7
7% Pref.	7	7	34/6	..	4 1 2
Northampton	10	10	46/3	..	4 6 7
Notting Hill 6% Pref. (£10)	6	6	9	..	—
Northmet Power:					
Ordinary	7	7	35/9	..	3 18 4
6% Pref.	6	6	32/6	..	3 13 10
Richmond Elec.	6	6	25/–	..	4 16 0
Scottish Power	8	8	39/6	..	4 1 0
Southern Areas	5	5	21/3	..	4 14 0
South London	7	7	26/–	..	5 7 8
West Devon	5	5	21/3xd	−3d.	4 14 0
West Glos.	4½	3½	20/–	..	3 10 0
Yorkshire Elec.	8	8	40/–	..	4 0 0
Overseas Electricity Companies					
Atlas Elec.	Nil	Nil	4/3	..	—
Calcutta Elec.	7*	7*	23/3	+⅛	6 0 5
Cawnpore Elec.	10	10	25/–	..	8 0 0
East African Power	7	7	27/–	..	5 3 8
Jerusalem Elec.	7	5	18/9	..	5 6 8
Kalgoorlie (10/–)	7½	7½	7/6	..	10 0 0
Madras Elec.	6*	4*	15/–	..	5 6 8
Montreal Power	1½	1½	23½	..	6 7 8
Palestine Elec. "A"	Nil	Nil	18/9	..	—
Perak Hydro-elec.	6	7	5/–	..	—
Shawinigan Power	83cts.	90cts.	14½	..	—
Tokyo Elec. 6%	6	6	12½	..	—
Victoria Falls Power	15	15	72/6	..	4 2 9
Whitehall Inv. Pref.	7½	5	15/9	..	6 7 0

Company	Dividend 1939–40	Dividend 1940–41	Middle Price May 26	Rise or Fall	Yield £ s. d.
Public Boards					
Central Electricity:					
1950–70	5	5	110½	..	4 10 6
1955–75	5	5	115	..	4 7 0
1951–73	4½	4½	109	..	4 2 7
1963–93	3½	3½	103½	..	3 7 8
1974–94	3½	3½	99	..	3 5 8
London Elec. Trans. Ltd.	2½	2½	95	..	2 12 8
London & Home Counties 1955–75	4½	4½	112	..	4 0 4
Lond. Pass. Trans.:					
A	4½	4½	119½	−1	3 15 4
B	5	5	116½	−1	4 5 10
C	3	2⅞	40½	..	7 2 0
West Midlands J.E.A. 1948–68	5	5	110	..	4 11 0
Telegraph and Telephone					
Anglo.-Am. Tel.:					
Pref.	6	6	112½	..	5 6 8
Def.	1½	1½	26	..	5 15 5
Anglo-Portuguese	8	8	15/–	+⅛	10 13 4
Cable & Wireless:					
5½ Pref.	5½	5½	98	+½	5 11 10
Ord.	4	4	58	..	6 18 0
Canadian Marconi $1	Nil	4cts.	5/–	..	3 7 0
Globe Tel. & Tel.:					
Ord.	8½*	8½*	27/6	..	—
Pref.	6	6	27/6	..	4 7 5
Great Northern Tel.: (£10)	20	20	14½	+1	—
Inter. Tel. & Tel.	Nil	Nil	3½	..	—
Marconi-Marine	7½	7½	28/9	..	5 4 4
Oriental Tel. Ord.	11½*	16	45/–	..	7 2 3
Telephone Props.	6	Nil	8/9	..	—
Tele. Rentals (5/–)	10	10	8/9	..	5 14 1
Traction and Transport					
Anglo. Arg. Trans.:					
First Pref. (£5)	Nil	Nil	5/–	..	—
4% Inc.	Nil	Nil	10½	..	—
Brit. Elec. Traction:					
Def. Ord.	45	45	925xd	+15	4 17 3
Pref. Ord.	8	8	180xd	..	4 9 0
Bristol Trams	8	10	46/3	..	4 6 4
Brazil Traction	$1	50c.	14	..	—
Calcutta Trams	8	5½	11/3	..	9 15 6
Cape Elec. Trams.	5	5	19/–	..	5 5 3
Lancs Transport	10	10	43/9	−⅛	4 11 4
Mexican Light:					
1st Bonds	5	5	82½	+1	6 1 3
Rio 5% Bonds	5	5	97½	..	5 2 8
Southern Rly.:					
5% Prefd.	5	5	64½	..	7 15 0
5% Pref.	5	5	110½	−1	4 10 6
T. Tilling	10	10	50/–	..	4 0 0
Tilling & B.A.	7*	6½*	55/–	..	2 7 3
West Riding	10	10	39/6	..	5 1 3

(Continued on next page)

* Dividends are paid free of Income Tax.

Company	Dividend 1939-40	Dividend 1940-41	Middle Price May 26	Rise or Fall	Yield p.c.
Equipment and Manufacturing					£ s. d.
Aron Elec. Ord. ..	Nil	7½	24/–	..	6 5 0
Assoc. Elec. :					
Ord.	10	10	45/–	..	4 9 0
Pref.	8	8	38/9	..	4 2 4
Automatic Tel.& El.	12½	12½	52/–	..	4 16 3
Babcock & Wilcox	11	11	43/9	..	5 0 6
British Aluminium	10	10	43/3	..	4 12 4
British Insul. Ord.	20	20	93/9	..	4 5 6
British Thermostat (5/–)	18½	18½	16/3xd	+1/9	5 13 10
British Vac. Cleaner (5/–)	12½	10	11/3	..	4 9 0
Brush Ord. (5/–) ..	Nil	6	5/6	+3d.	5 9 3
Callender's ..	15	15	72/6	..	4 2 9
Chloride Elec.Storage	15	15	73/9	..	4 1 4
Cole, E. K. (5/–) ..	Nil	7	11/–	..	3 3 8
Consolidated Signal	17	17	72/6	..	4 3 8
Crabtree (10/–) ..	17½	17½	29/6	..	5 18 8
Crompton Parkinson Ord. (5/–) ..	30	20	22/6	..	4 9 0
E.M.I. (10/–) ..	Nil	6	15/–	+9d.	4 0 0
Electric Construction	10	10	34/6	..	5 16 0
Enfield Cable Ord.	12½	12½	55/–	..	4 11 0
Elecl. Switchgear (10/–)	10	10	20/–	..	5 0 0
English Electric ..	10	10	42/–	+9d.	4 15 3
Ensign Lamps (5/–)	25	25	16/3	..	7 13 10
Ericsson Tel. (5/–)..	22*	20*	41/3	..	2 8 6
Ever Ready (5/–) ..	40	40	32/–	+6d.	6 5 0
Falk Stadelmann ..	7	7½	22/–	..	6 16 4
Ferranti Pref. ..	7	7	27/6	..	5 1 10
G.E.C. :					
Pref.	6½	6½	35/–	..	3 14 2
Ord.	20	17½	83/9	..	4 3 9
Greenwood & Batley	15	13	29/6	..	8 16 4
Hall Telephone(10/–)	10	12½	20/–	..	6 5 0
Henley's (5/–) ..	20	20	22/6	..	4 9 1
4½% Pref. ..	4½	4½	22/6	..	4 0 0
Hopkinsons ..	15	15	48/9	+6d.	6 3 0
India-Rubber Pref.	5½	5½	21/3	..	5 3 6
Intl. Combustion ..	32½	30	107/6	..	5 11 6
Johnson & Phillips	15	15	60/–	..	5 0 0
Lancashire Dynamo	20	20	67/–	..	5 19 4
Laurence,Scott (5/–)	15	12½	9/–	..	6 19 0
London Elec. Wire	7½	7½	28/3	..	5 6 2
Lucas, J.	15	15	65/–	..	4 12 4
Mather & Platt ..	10	10	39/6	..	5 1 3
Metropolitan Elec. Cable Pref. ..	5½	5½	21/3	..	5 3 6
Murex	20	20	91/3	–½	4 7 3
Pye Deferred (5/–)	25	25	15/–	..	8 6 8
Revo (10/–) ..	5	20	28/9	..	6 19 2
Reyrolle	12½	12½	57/6	..	4 7 0
Siemens Ord. ..	7½	7½	26/3	..	5 14 3
Smith, S. (1/–) ..	50	37½	7/–	..	5 7 2
Strand Elec. (5/–)..	2	4	3/6	..	5 14 4
Switchgear & Cowans (5/–) ..	15	10	10/–	..	5 0 0
T.C.C. (10/–) ..	Nil	5	12/6	..	4 0 0
T.C. & M.	10	10	41/3	..	4 17 0
Telephone Mfg. (5/–)	9	9	9/3	..	4 17 3
Tube Investments	23¾	20	82/–	..	4 17 7
Vactric (5/–) ..	Nil	Nil	6/–	..	—
Vickers (10/–) ..	10	10	16/9	..	5 19 5
Ward & Goldstone (5/–)	20	20	18/6	..	5 8 3
Westinghouse Brake	10	10	47/6	..	4 4 2
WalsallConduits(4/–)	55	55	33/9	..	6 10 4
West, Allen (5/–) ..	7½	7½	5/9	..	6 10 5

* Dividends are paid free of Income Tax.

Stocks and Shares (*Concluded from page* 708)

is increased to £69,000, this representing approximately the increase in the trading profit. The shares at 5s. 9d. give a return of 6½ per cent. on the money and are regarded as a good industrial investment. As a rule, a free market prevails in the shares.

The British Thermostat Co.'s net trading profit of £45,200, which is also for the year to January 31st last, was £21,800 down, but the dividend for the year, 18½ per cent., is unchanged. Prior to the announcement, some doubt had been entertained as to whether the company would be able to maintain the 18½ per cent. rate. On the appearance of the report, the price rose 1s. 9d. to 16s. 3d., at which shares changed hands last week.

A Pleasant Surprise

Calcutta Electric Supply shares made a sharp recovery upon declaration of a dividend making 7 per cent., free of tax, the same as that for the previous twelvemonth. The declaration came as a pleasant surprise, for it had been generally expected that the company would cut the rate to 5 or 6 per cent. net. Buyers immediately came forward. Some of them gave up to 24s. 3d. for the shares, this price comparing with 18s. at the beginning of the current month. The announcement had a strengthening effect upon other Indian industrials, including Madras Electric, Cawnpore Electric and Calcutta Trams. At the middle price of 23s., Calcutta Electrics, on a 7 per cent., free of tax, dividend basis, return 6 per cent., free of tax, to the purchaser.

Were it not for war conditions, it would be fair to assume that for at any rate a few years to come, the ordinary shares of the Madras Electric Supply Corporation would receive not less than 4 per cent. tax free. From 1930 to 1938 inclusive, the company paid an 8 per cent. dividend each year, reduced it to 6 per cent. in 1939, and for 1940 distributed 4 per cent. All these dividends have been paid tax free. Last December's interim dividend of 1½ per cent., free of tax, is expected to be made up to the 4 per cent., which, as already observed, it would seem to be reasonable to expect to continue. Shares are on offer at 15s. 6d., which, on a 4 per cent. net dividend basis, would give a return of £5 3s. 3d. per cent., equivalent to £10 6s. 6d. per cent., taking tax at 10s. in the £.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (1*s. each*) *can be obtained from the Patent Office*, 25, *Southampton Buildings, London, W.C.*2.

1940

8525. "Radio receiving apparatus." Fabbrica Italiana Magneti Marelli. May 12th, 1939. (544808.)

14631. "High-frequency modulating systems utilising electron beam discharge devices." British Thomson-Houston Co., Ltd. September 27th, 1939. (Addition to 541271.) (544850.)

15708. "Indication or control of the performance of synchronous dynamo-electric machines." E. Barraclough and P. A. H. Mossay. October 25th, 1940. (544920.)

15710-3. "Dynamo-electric machines." British Thomson-Houston Co., Ltd. October 25th, 1939. (544921-4.)

15831. "Driving means for reels on which material is coiled." English Electric Co., Ltd., and H. S. Carnegie. October 29th, 1940. (544925.)

15883. "Interference eliminator for wireless receivers." F. E. Bole, C. M. Edwards and J. B. MacLaughlin. October 30th, 1940. (544893.)

15893. "Electric contact springs for light current purposes." Automatic Telephone & Electric Co., Ltd., and W. Saville. October 30th, 1940. (544894.)

16148. "Electric lamp and reflector fittings." F. W. Thorpe, Ltd., and F. W. Thorpe. November 6th, 1940. (544895.)

16618. "Electric motor control systems." Igranic Electric Co., Ltd. November 18th, 1939. (544787.)

17050. "Supporting of thermionic valves, or like electron-discharge devices." United-Carr Fastener Corporation. December 15th, 1939. (544825.)

17709. "Tension control devices for electrically driven reels." British Thomson-Houston Co., Ltd. December 16th, 1939. (544900.)

1941

3. Variable control of electric currents by reactances." British Thomson-Houston Co., Ltd., and H. V. Rose. January 1st, 1941. (544828.)

723. "Indicating devices associated with electrical switches," Revo Electric Co., Ltd., and F. H. Reeves. January 18th, 1941. (544829.)

1446. "Thermionic cathode-controlled arc discharge devices." British Thomson-Houston Co., Ltd., and H. de B. Knight. February 4th, 1941. (544831.)

1447. "Dynamo-electric machines." M. W. Woods, Ltd., and B. B. Daly. February 4th, 1941. (544832.)

3119. "Electric circuit-breakers." British Thomson-Houston Co., Ltd. March 8th, 1940. (544932.)

3397. "Antenna interference eliminator for wireless receivers." F. E. Bole, C. M. Edwards and J. B. MacLaughlin. October 30th, 1940. (Divided out of 544893.) (544933.)

3491. "Piezo-electric crystal apparatus." Standard Telephones & Cables, Ltd. March 29th, 1940. (544834.)

6348. "Fluid-blast electric circuit-breakers." British Thomson-Houston Co., Ltd. May 16th, 1940. (544798.)

6615. "Mercury boilers." British Thomson-Houston Co., Ltd. May 25th, 1940. (544799.)

7705. "Methods of and means for protecting alternating-current electric systems." British Thomson-Houston Co., Ltd. June 19th, 1940. (544838.)

8517. "Electrical transformers," Akt.-Ges. Brown, Boveri & Cie. July 20th, 1940. (544807.)

8947. "Apparatus for use in electroplating." Mond Nickel Co., Ltd. July 15th, 1940. (544839.)

8965. "Gas-blast circuit-breakers." British Thomson-Houston Co., Ltd. July 16th, 1940. (544871.)

9581. "Cement asbestos insulating materials." British Thomson-Houston Co., Ltd. July 31st, 1940. (544842.)

10177. "Contact selector, chiefly designed for use in remote control installations." Landis & Gyr Soc. Anon. August 31st, 1940. (544874.)

16678. "Electro-magnetic slip couplings." English Electric Co., Ltd., and H. S. Carnegie. October 29th, 1940. (Divided out of 544925.) (544941.)

Forthcoming Events

Institution of Electrical Engineers.—*Devon and Cornwall Sub-Centre.*—Thursday, June 25th, 5.30 p.m. (tea, 5 p.m.), Callard's Café, 42, Fleet Street, Torquay. Paper: "Electrical Industrial Installations," by Mr. L. C. Grant.

North Midland Students' Section.—Saturday, May 30th. Hotel Metropole, Leeds. 1.45 p.m., luncheon. 2.45 p.m., annual meeting followed by exhibition of films.

Western Centre.—Monday, June 8th, 5 p.m. Merchant Venturers' Technical College, Bristol. "Brains Trust."

British Institution of Radio Engineers.—Friday, May 29th. 21, Tothill Street, S.W.1. 6.30 p.m., annual meeting. 7 p.m., paper: "Time Bases," by Mr. O. S. Puckle, A.M.I.E.E.

Electrodepositors' Technical Society.—Tuesday, June 2nd, 6 p.m. James Watt Memorial Institute, Gt. Charles Street, Birmingham. "Electrodepositors' Brains Trust."

Monday, June 8th, 5.30 p.m. Northampton Polytechnic, London, E.C.1. Paper: "The Brytal Process for the Anodic Oxidation of Aluminium," by Mr. E. Ensor.

Institution of Mechanical Engineers.—*Midland Branch.*—Thursday, June 4th, 6 p.m. James Watt Memorial Institute, Birmingham. Joint meeting with Institution of Electrical Engineers and Institution of Production Engineers to consider "The Application of Statistical Control to the Quality of Materials and Manufactured Products." The subject will be introduced by Dr. C. G. Darwin and Sir Frank Gill.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

Contracts Open

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia. — QUEENSLAND. — August 20th. Townsville Town Council. 3,000-kW turbo-alternator (Specification 119). A. Robertson, town clerk, Townsville.

Ellesmere Port.—May 30th. Urban District Council. Installation of electricity in dometic communal shelters. Plans, specification, and form of tender from the engineer and surveyor, Civil Defence Headquarters, Queen Street, Ellesmere Port. Tenders to P. J. Hodges, clerk, Council Offices.

Plymouth.—May 30th. City Electricity Department. Condenser tubes, screwed glands and washers. (May 15th.)

South Africa.—SALISBURY.—July 2nd. City Council. Electrical metering equipment. (Contract E.19.)

Orders Placed

Darlington. — Corporation. Accepted. Motor-generator for charging trolley-bus batteries (£116).—English Electric Co.

Swansea.—Electricity Committee. Accepted. Central evaporating plant (£13,859).—Hick Hargreaves & Co. Air compressors and auxiliaries (£7,877).—Browett, Lindley & Co. Auxiliary starting and control gear (£6,300).—Brookhirst Switchgear.

York.—Electricity Committee. Accepted. Water softening plant for power station (£376).—Kennicott Water Softeners.

Contracts in Prospect

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Ardwick.—Works additions; F. Almond, architect, 16, Kennedy Street, Manchester, 2.

Barrow-in-Furness.—Additions to maternity home; borough engineer.

Beswick.—Offices and extensions to dairy, Bosworth Street and Grey Mare Lane, for Beswick Co-operative Society Ltd.; Co-operative Wholesale Society, Ltd., Architects' Dept., Balloon Street, Manchester, 4.

Blackley.—Works extensions; C. Holmes, architect, 39, Well Street, Bradford.
Boiler house; Russell Building & Contracting Co., Ltd., 165, Plymouth Grove, Manchester, 13.

Bootle.—Ambulance depot (£2,148); borough engineer.

Burton Latimer. — Adaptation of "The Poplars" as administrative offices for the U.D.C.; C. A. Borman, surveyor, Council Offices.

Collyhurst.—Works additions; Sharp & Cowburn, architects, 40, King Street South, Deansgate, Manchester, 3.

Coventry.—Erection of buildings on Whitley Abbey site, adaptation of "Elm Park," Stoke Park, for school extensions and completion of Dane Road Secondary School; D. E. E. Gibson, city architect, 1a, Warwick Row.

Edinburgh.—Conversion of church, Tranent, into cooking depot; city architect.

Gorton.—Works extensions; H. Burke & Son, civil engineers, Green Lane, Brook Street, Chortlton-on-Medlock, Manchester, 1.

Kent.—Extensions, Orpington Institution (£1,635); County Hospital, Pembury (£6,550); county architect, Maidstone.

Lancashire.—Erection of a prefabricated building as extensions to the Leyland senior schools; A. Evans, county architect, County Offices, Preston.

London.—CAMBERWELL.—Nursery at Magdalene College Boys' Club, Wyndham Road (£2,020); borough surveyor, Town Hall, Peckham Road, S.E.5.

Manchester.—Offices; W. E. Cary, Ltd., Red Bank, Manchester, 4.
Rebuilding warehouse and offices; R. Martin, architect, 90, Deansgate, Manchester, 3.
Works extensions; J. Riley & Sons, building contractors, 59, Forge Lane, Manchester, 11.

Middlesbrough.—Wartime nurseries at Fleetham and on site to be decided; C. Gorman, borough engineer.

Newcastle-on-Tyne.—Three nurseries in prefabricated huts for the City Council (£5,700); E. Thompson, builder, 12, Grey Street, Newcastle.

Nottinghamshire.—Day nurseries at Harworth, Eastwood and Ruddington; county architect, Shire Hall, Nottingham.

Rowley Regis.—Feeding and rest centres at seven schools, and building for day nursery; borough surveyor, Old Hill, Cradley Heath.

Staffordshire.—Day nursery, Bolehall Park, Tamworth; K. L. Murray, county architect, County Buildings, Stafford.

Tottenham.—Restoration and provision of canteen and kitchen; A. & W. Flatau & Co., Ltd., wholesale boot manufacturers, Hale, N.17.
Extensions; Keith Blackman, Ltd.
Extensions; G. Johnson Bros.

Twickenham.—Civic restaurant, 33-35, High Street, Whitton, and nursery (40 children), Heathfield School, Powdermill Lane; borough surveyor, Municipal Offices, York House.

Urmston.—Alterations to premises, Trafford Park, for N.F.S.; E. L. Leeming, U.D.C. surveyor, Crofts Bank Road, Urmston.

Whitehaven.—Nursery, site adjoining Flatt Walks; borough surveyor, Town Hall.

Withington.—Extensions to laundry buildings for Withington Laundry Co., Ltd.; Hibbert & Penn, Ltd., builders, Clwyd Avenue, Edgeley, Stockport.